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A
COMPLETE SYSTEM
OF
PRACTICAL ARITHMETIC,
(Both VULGAR and DECIMAL)
On an entire new Plan;

The DEFINITIONS, GENERAL RULES, and *many of the* EXAMPLES being VERSIFIED, and the whole made exceeding easy and familiar to the meanest Capacity, being done in such a Manner as to render the Study of ARITHMETIC *delightful* as well as instructive to both Sexes.

TO WHICH IS ADDED,

A large Collection of NEW QUESTIONS, with only the ANSWERS thereto;

The other EXAMPLES, or QUESTIONS, being many of 'em work'd at full length.

By THOMAS SADLER.
Teacher of the Mathematics in *Whitchurch, Shropshire*.
Author of the *Harvest Field Poem*, and of several *Poetical* and *Mathematical Miscellanies*, &c.

ARITHMETIC *that useful curious Art*
Refines the Man and brightens ev'ry Part
ARITHMETIC! *by thy all pow'rful Aid*
Wealth is secur'd and all the Fruits of Trade
We learn by FIGURES *to demonstrate true*
And reason just by Precepts ever new.

SHREWSBURY:
Printed for the AUTHOR, by W. WILLIAMS.
And sold by all *Booksellers* in Town and Country.
M, DCC, LXXIII.

ADVERTISEMENT.

For the Benefit of Youth, and other Persons who are desirous of being instructed in the most useful parts of the Mathematical Sciences.

THE AUTHOR of this Treatise, begs leave to acquaint his Friends and the Public, that he will continue (if health permit) to teach WRITING in all the hands practised in *Great-Britain*, ARITHMETIC (*Vulgar* and *Decimal*, according to the plan of this Treatise, by which he will engage to bring Youth on to the knowledge of Figures, in half the time taken up by some Teachers.) BOOK-KEEPING, GEOMETRY, TRIGONOMETRY, MENSURATION in all its various parts, GAUGING, DIALING, GEOGRAPHY, and the use of the GLOBES; (*having purchased a new pair for that purpose*) ALGEBRA, FLUXIONS, ASTRONOMY, and NAVIGATION, according to the best Methods used by the most celebrated Authors.

Note. Gentlemen's Estates Surveyed, and Mapped in the best manner, Marl-pits and Hay-recks Measured, and all kinds of Artificers' Work, by the *Author*, (on reasonable terms) by whom Youth will be made fit for Sea, Excise, or any public Office, *&c. &c.*

To the Honourable Sir WATKIN WILLIAMS WYNNE, *Bart. and Knight of the Shire, for the County of Salop.*

HON^D. SIR,

THE Consideration of that *glorious Family* from which You spring, which has ever stood foremost in the Patronage and Support of whatever may be deem'd beneficial, or useful to the Public Weal, joined to that Candour and Urbanity which You so eminently possess, emboldens the Author of this *Arithmetical Treatise*, humbly to beg leave to *shelter it under* YOUR PATRONAGE, which he hopes will be found to be formed upon a Plan at once easy, useful, and pleasant; and in short, to answer the end the Author intends, which is to

lead

lead Youth in an agreeable manner, to the ſtudy of a thing of ſuch public and private Utility. Theſe ends the Author flatters himſelf will be anſwered by a careful peruſal of the following Sheets, by thoſe for whoſe Uſe they were principally drawn up, *viz.* the *Tyros* in *Arithmetic*, ſeveral Gentlemen eminent in the Mathematics having peruſed them with Approbation.——Not to treſpaſs upon YOUR HONOUR'S Time, and to wave the hacknied Track of Dedication, (tho' I cou'd dilate with pleaſure upon the *admired Character* of *Sir* WATKIN WILLIAMS WYNNE) I beg leave to ſubſcribe myſelf

YOUR HONOUR'S moſt obedient,

humble Servant,

T. SADLER.

THE PREFACE.

THE use of ARITHMETIC is so great in all common affairs of life, and amongst all degrees of people, that no man can say without erring from truth,—" ARITHMETIC *is of no use, or consequence to me, I mind it not.*" The *Statesman*, even an *Emperor* himself must call in *its aid* at certain times, and upon sundry occasions. If it were not for the knowledge of *Figures*, what wou'd become of Trade, Commerce, *&c.*

What induced me to write a Treatise of PRACTICAL ARITHMETIC after so many excellent Authors who have wrote before me, were the following motives.

First, I observed none had attempted to write upon the plan I offer to the public, *i. e.* of versifying the general Rules for the ease of Memory. And Secondly, few had given the Operations work'd at Length: This was an article I have heard a great many complain of, even Teachers themselves.

As to the Work itself, it is laid down upon the best foundation I cou'd procure from the most celebrated Authors; the Rules (tho' *versified*) are built upon the best principles now taught and practised by the most eminent Masters of our private or public Academies, or Schools in this Kingdom; every difficulty is explained in the most concise and best methods, and the whole of the performance made perfectly easy to be understood, (even by the meanest capacities) by precepts so naturally easy, as to lead Youth on without the help of any other Instructor — By the help of this Treatise, any young man of a

tolerable capacity, may in a ſhort time make himſelf maſter of the moſt difficult parts of ARITHMETIC.

I have often obſerved many young people of the lower claſs, (whoſe parents were not able to give them a proper Education) have by their own Induſtry, Ingenuity, and the help of good Authors, become very good Accomptants, got preferment, and advanced themſelves to very great fortunes. It muſt be allowed to be no ſmall difficulty for a perſon in a ſervile ſtate, who earns his bread (perhaps) by the ſweat of his brow, to make much proficiency in the Sciences, but where wou'd all the *Mæcenaſes* of the age be, if the few ſpare hours allotted to ſleep were not on their ſide? To anſwer which we'll ſay, " buried in oblivion."—But it is well known from the writers of all ages, that the *Goddeſs of Wiſdom*, does not always deſcend in a golden ſhower, or crown her favourites with diadems and coſtly pearls. No! rather with knowledge, for even the loweſt and meaneſt Cottager may wear her Laurels, as ſoon as the greateſt Monarch upon Earth. This I hope every impartial Reader will allow; to favour which, I ſhall give a quotation from a letter I received many years ago, from a learned gentleman (Mr. *Tarrat* of *Epſom*) whoſe name is well known to the public. " *A perſon's elevation*" (ſays my friend) " *moſtly ariſes from accidents.*—Ferguſon *is a ſelf taught Philoſopher.*— Martin *the ſame.* Simpſon *was a very poor Weaver, and by an extraordinary accident was brought to* London, *and introduced to the Academy of* Woolwich. Thomas Grimmet, *a Ship Carpenter in the Yard at* Deptford, *by an accident of a broken thigh, was introduced to copy Accounts in an Office, became a very good Mathematician, a Meaſurer in the Yard and died worth £14000, a few years ago; I could enumerate five hundred inſtances if I had paper, room and time.*"

It

It may be said with regret, that too little regard is paid to *both sexes*, (especially the *female*) in instructing or having them instructed, by persons properly qualified for such a purpose, in so noble, so extensive, and useful a branch of learning as ARITHMETIC.—"ARITHMETIC," (says the celebrated Mr. *Malcolm* †) "*is a subject of that extent, that in some* "*respects* it *can never be exhausted, and of that value* "*as to deserve all that study and pains that can be* "*bestowed upon* it." Mr. *Emerson* says also, "*No* "*Business can be carried on without the help of* NUM-"BERS, *no Trade or Commerce exercised without* "REGULAR ACCOMPTS, *so that in all situations of life,* "ARITHMETIC *is a necessary accomplishment.*" Mr. *Locke* says in his Essay on Human Understanding, "*All those should be taught who have time and op*-"*portunity, the Art of* NUMBERS, *not so much to* "*make them Mathematicians, as to make them rea*-"*sonable Creatures*: What a true conception of the powers of ARITHMETIC possessed *Solomon*, when he uttered that just assertion. "*Thou O Lord hath dis*-"*posed all things in Measure, Number and Weight.*" From the above citations we behold the intrinsic value of NUMBERS, in the words of the greatest Philosophers that ever existed, whose monuments of refined knowledge will stand the test of all ages. Then what a pity it is, that parents whose abilities and fortunes will enable them, would be careful to have their children well instructed in such necessary attainments.

It is well known that the genius of the *fair Sex* is as penetrating as ours, a Lady of fortune by the help of NUMBERS, can adjust her accompts with her Steward; also, the Mechanic, Tradesman, or Farmer's Wife is able to book and accompt in her Husband's absence. To encourage my Female Readers, I shall

† *In his Preface to his* Arithmetic, *page* 1.

give them a Poetical Opinion of a *learned Lady*, from one of her Letters of Correspondence written to me some years ago. She descants thus,

"*How few alas! in this degen'rate age,*
"*Employ their noble faculties, and pow'rs*
"*In scientific knowledge,—rich supplies*
"*From thence we draw; nor will the Fountain cease*
"*To flow, 'till time itself shall be no more,*
"*And nature sinks beneath the gen'ral fire.*
PHILLIPS."

Having for a series of upwards of twenty years taken great delight in reading the Annual Publications, *viz.* the Diaries, Palladiums, and such delightful Miscellanies, I have observed the Questions (tho' ever so intricate to be solved) when humourously versified, have tended greatly to the amusement of *both sexes*, only for the reading part; much more entertainment must they give to the ingenious *Tyro* who can solve them. This was one motive why I proposed so many Examples in this Treatise in Verse, I did it purely to excite the learners attention to the study of FIGURES, or ARITHMETIC; to mix knowledge with delight, and by that means entice as it were the ingenious learners to climb the most difficult precipice with pleasure. I think nothing can strike a deeper impression upon the mind, than having the Rules delivered in Verse, and learned perfectly by heart; this not only serves the present purpose, but is much stronger retained in memory, than a page of dry prose writing; not by children only, but by adult persons also.

The Questions in Verse as they are humourous and innocent, I hope they will be looked upon also, as proper and agreeable recreations for *both sexes*.—Some of these Questions perhaps may be thought too long for a Master to copy out to his Pupils, but this

is quickly remedied, by giving the ſubject of the Example in Proſe; but more delightful, as well as beneficial it will be, for the ingenious Pupil, to write or copy theſe out himſelf, as well as the Definitions and Rules: all this will add to a creative mind, and improve the uſe of the PEN, as well as FIGURES.—— It is a thing almoſt impoſſible for Maſters (even of the ripeſt judgment) in large Schools to teach without the help of an Author; or, even when there are ſeveral Pupils waiting with their performances to be examined, to perform their duty, without having the operations at hand to what they propoſe, by having the whole operation immediately open to the eye an error is ſoon diſcovered, and a deal of time ſaved; it is true when a Maſter knows the Anſwer, and his Pupil is wrong, he may check him, bid him go and find it out, but this will only curb his ingenuity, ſtupify his ſenſes, loſe his time, and be detrimental both to himſelf and Parents. In my humble opinion nothing comes up to encouragement, by giving youth a proper idea of the matter they have in hand, and then they will go thro' their performances with eaſe and perſpicuity; according as their genius or inclination may lead them.

Perhaps ſome of our moſt eminent Teachers and Mathematicians may ſay, I have inſerted too many operations at length, as this may be a means of encouraging dull and lazy boys to copy out their Anſwers, and by that means think to deceive the Maſter, but ſuch kind of piracy may ſoon be detected. To remedy this, I have added a compleat collection of new Queſtions at the end of this Treatiſe, in every Rule, with only the Anſwers. Any of theſe Queſtions when given to the Pupil will ſoon put him to a ſtand; make him reflect on what he has done, and ſet his thoughts to work, to enquire into the true principles and nature of working his Queſtion, as *per*

Rule

Rule, but it wou'd be in vain to give a Pupil any of the Questions before he has got a perfect knowledge of the Rule to which they belong.

In this place I cannot help taking notice of the great use this Treatise must be, to those persons who have not time and opportunity, (and perhaps cannot afford) to have a Master's instruction; here they will see how every Example is, or ought to be done; and may quickly by their own application, make themselves complete masters of the whole Treatise.—— Those persons also, who have negligently forgot what they have learned at school, may here quickly regain what they have occasion for, according as their business or situation may require.

As to the order of the Rules in this Treatise, I have placed them as I thought most properly they shou'd be learned; but every Master may use his own pleasure, and teach them in what form he likes best.

I have observed many good Authors take the method of transcribing many of their questions from other men's writings, without mentioning the name of the real Author, or to whom they were obliged for them; this is rather an unfair way of proceeding, in my opinion every author ought to shine in his own plumes; this occasioned my inserting the Authors names to the Promiscuous Questions, &c. In regard to proposing new Questions in Arithmetic, I must confess, it is almost impossible to frame any thing new, but what shall be similar to what has been wrote before by others; because the use and application of Figures is the same as in former ages; but then it must be allowed that new improvements have and will be made, and a new dress given to every Man's performance, perhaps as long as this world shall exist.

I must certainly expect, (when even the best of Authors,

thors, and most celebrated Mathematicians have done the same) to be carped at by some ill natur'd Critics, who wou'd endeavour to *throw down a Castle*, if but *one Stone* stood crooked in the *whole fabric*; but this will make but little impression upon me, as I do not pretend to such niceties. What I have done is purely for the benefit of the unlearned, and the instruction of our *British* Youth.—So I hope every impartial reader, and lover of truth, will judge for himself of the merits of this Performance; and if it meet with the approbation of my worthy subscribers, and the public in general; I shall not think I have spent so much labour in vain, but rejoice at having done any thing that may be serviceable, and for the good of my country.

By reason of the many indispensible avocations which prevented me from attending the press, my judicious Readers may perhaps find a few typographical errors and slips of the pen, which are scarce possible to be avoided in printing so large a Treatise as this; therefore (and as I have drawn up no *Errata*) I hope they will candidly excuse and correct what errors they may occasionally find herein, and that, as well as all other favours shall be gratefully acknowledged by

Whitchurch *their most obedient humble Servant*
April 25th, 1773. THOMAS SADLER.

On

On the Excellence and extensive Use of *ARITHMETIC.*

Hinc omne principium, huc refer exitum. Hor.

THE path by which aspiring mortals climb
To Wisdom's Fane, and compass truths sublime,
I sing —— *Castalian Maids!* inspire my song,
Soft let the tuneful numbers roll along
As Spring-gales wafted from *Favonious'* wings,
And sweet as sounds that flow from *Delphian* strings.
ARITHMETIC's my theme !—O heav'n born Fair !
(If science merit thy distinguish'd care)
Thou, *Pallas*, aid !—— to heights untry'd before,
Indulgent Goddess ! teach my thoughts to soar.
ARITHMETIC ! —— The name can re-inspire
The languid *Muse*'s half-extinguish'd fire :
Oh ! cou'd that *Muse* on Eagle's pinions rise,
From this low Earth to yon' cerulean Skies ;
Amidst siderial worlds *thy* praise I'd sing,
And with *thy* fame the distant spheres shou'd ring.
ARITHMETIC ! to *thee* we justly owe,
Whate'er of Arts, or Sciences we know ;
From *thee* they spring, —— on *thy* support depend ;
Thou art their *Primum Mobile* —— and end.
Thy various useful properties are known,
In ev'ry distant land from *Zone* to *Zone*,
Where truth prevails, and erudition's ray,
Darts on the soul, and yields a mental day:
But *Britain*'s first thy just applause to sound,
Britain, not less for arts than arms renown'd.
By *thee* her *NEWTON* rose aloft to fame,
And as the stars immortaliz'd his name,

By

By *thee* fair *Commerce* lives, and kindly pours
Un-number'd bleſſings on her ſea-lav'd ſhores:
With majeſty benign the Goddeſs ſmiles,
And crowns with opulence the *Queen of Iſles*.
Daughter of *Concord! thee Britannia* hails,
Whoſe glories blaze beneath thy foſt'ring ſails,
Whence to her temp'rate climes the fruits are hurl'd,
Of hot *Golconda*, and the *Polar World*.——
ARITHMETIC! without thy pow'rful aid,
Could Reaſon's keeneſt eye the gloom pervade,
Where white-rob'd Truth her lovely form enſhrouds,
And veils her face in ſcientific clouds?
Reaſon unaided, at the beſt we find,
The dawn of knowledge on the human mind;
But by *thy* pow'r the faculty divine,
Improv'd with ſtronger rays begins to ſhine;
From truth to truth *thy* precepts point the way,
'Till the weak twilight brightens into day.
So when hot *Sol* from *Thetis'* cold embrace
Aſcends, and in the Eaſt unveils his face,
The gloomy ſhades recede before his eye,
And perfect day-light blazes thro' the ſky.
All hail, BLEST ART!——but Oh! my feeble lays,
Degrade *the ſubject* I attempt to praiſe:
A theme ſo great — ſo noble, does require
A *POPE*'s pure diction, and a *MILTON*'s fire.
Great *EMERSON*, whoſe energetic ſoul
No ſpace can bound—no obſtacle controul;——
Whoſe learning will to lateſt ages ſhine,
And ſtamp his name with honours half divine,
Expatiates with delight, and ſtill profound
O'er all th' extenſive mathematic round:
But where had been his fame without *thy* aid?
Interr'd beneath Oblivion's ten-fold ſhade!
'Twas *NUMBERS* gave his mighty genius birth,
And made his thoughts aſpire above the Earth.
Fam'd *HUTTON* too, in ſcience deeply taught,
With all his vaſt profundity of thought,

Without the help of *NUMBERS* ne'er had shone,
Or made his curious, useful The'rems known.
By *NUMBERS* taught the *Bards* divinely sing,
And by soft *NUMBERS* charm the Lyric string.
PARENT of ARTS! (esteem'd by great and small)
Whose wide, unbounded use extends to all;
'Tis *thine* to teach, and beautify the mind,
'Tis *thine* to bless, and dignify mankind;
——*Thine* by un-erring rules to ascertain
The Merchant's treasure, and the Tradesman's gain.
'Tis *thine*——but Ah! my utmost efforts fail,
Thy worth—*thy* countless merits to reveal:
'Tis not in language less than that divine,
To tell what matchless excellence is *thine!*
Hence may *thy Rules*, by *SADLER*'s mode explain'd,
Be learn'd with pleasure, and with ease retain'd:
Hence *thy* Examples more and more admir'd,
And *British* youth with emulation fir'd,
Pursue *thy* precepts, with renew'd delight,
'Till taught to reason well, and judge aright:
So shall *Minerva* crown their glorious toil,
And raise an *Athens* in her fav'rite Isle.

BENJAMIN WEST.

Weedon-Beck in *Northamptonshire*,
January 15th, 1773.

LETTERS OF RECOMMENDATION.

To Mr. THOMAS SADLER, *on his New System of* PRACTICAL ARITHMETIC.

SIR,

UPON a perusal of your *Arithmetic*, I think it incumbent on me, (as a well-wisher to the literary world) to recommend it in the most express terms,

terms, as the most useful, ingenious (considering the versification) and elegant performance I have met with, not only for initiating youth into *Arithmetic* (as the Questions are many of 'em wrought at length) but useful also for several Schoolmasters, who having had no liberal education, are often deficient in the true methods of Solution. To all such I recommend it sincerely, and hope it will be found a very useful and valuable Manual; —and that you may have all the encouragement due to such a performance, is the hearty desire of

Your humble Servant and Well-Wisher;
P. ANTROBUS.

In Authoris laudem, et opera ejus.

YOUR Book needs not require a greater fame,
Than bear the title of *T. SADLER*'s name;
Let *Zoilus* alone, his envy's far below
That art you here unto the world do shew:
The pious *Watts* with all his sacred lays,
Was he now living cou'dn't augment your praise,
So fam'd your works; friend *SADLER* may you still,
Go on to write, as you've begun with skill:
And may your future arts resound in praise
More noble, and sublime than bards can raise.

Corripe lora manu, nec sit mutabile pectus
In te, consiliis utere tuque tuis,
Macte tua sic Arte brevi facis iter ad Figuras
Arithmeticæ *pandis commodius que vias;*
Tu elementa prima; Tu tota opera quoque
Numerandi doces, perge, et amice vale.

P. ANTROBUS.

Dabem de Schola Middlewich,
in Provincia cestrensi pridie
Nonas Januarii, anno post
Natum Christum; 1773.

To Mr. THOMAS SADLER *on his New Treatise of* ARITHMETIC.

SADLER! thy genius makes the world admire,
And wonder how ſuch art thou didſt acquire
To write ſo well, digeſt thy rules ſo clear,
Herculean labour, to compleat what's here
With ſo much truth, laid down conſpicuouſly,
For th' uſe of man! ſo graceful to the eye. —
But well I know, that an induſtrious mind
Makes hard things eaſy, to inſtruct mankind.
Thanks, thanks, my friend, are for thy labours due,
Candour ſays ſo, and Fame reports it true,
Thou haſt preſcribed here, a noble plan,
To charm the youth, t'invite th' unlearned man,
To taſte of '*RITHMETIC*'s moſt uſeful ſtore,
Worth more intrinſic, than all *India*'s ore.
With pen and ink, *it*'s value none can write,
Nor can the thought of man the ſame indite,
Great places, and preferments are attain'd,
By thoſe who in *it*'s art, have knowledge gain'd.
Hail ſprightly youths! theſe pages learn with ſpeed;
And richer ornaments will ſoon ſucceed.
Ye ſoft, engaging, lovely fair! attend,
Here's pleaſure with inſtruction nicely penn'd.
ARITHMETIC in verſe, here, here alone we view,
Compil'd with ornament, quite modell'd new.
In ev'ry page, throughout this work we find,
Fit, curious queſtions, to improve the mind
Of youth, and age, whoſe early days' paſs'd by,
Unmindful of *this* uſeful, rich ſupply,
Without *whoſe* aid, the Merchant muſt reſign,
All trade at home, and to each diſtant Clime;
The meaner Tradeſman readily will own,
His buſ'neſs without *it*, cou'd not go on.
By this it's plain th' ALMIGHTY has conſign'd,
The art of *NUMBERS* to improve mankind,

In

In trade, and commerce, which on golden wings,
Bear wealth immenſe t'adorn the Throne of Kings.
Then let not envy's baneful tongue pretend,
To blaſt this Work, with *good intention* penn'd:
Nor let the *Critic* with ungen'rous mind
Deſpiſe the whole, if he by chance ſhou'd find
A few ſmall errors, but to mind recall,——
We err by cuſtom, ſince old *Adam*'s fall.
May'ſt thou my friend, meet merit's juſt reward
For ſuch great labour, penn'd with due regard,
T'inſtruct the age in *NUMBERS* and prepare
The youth for buſineſs with the ſtricteſt care,
Oh! may'ſt thou be rewarded for thy pains,
And wear the *Laurel* that true merit gains.

JOHN HOPLEY.

Occleſtone near *Middlewich*,
February 1ſt, 1773.

To Mr. THOMAS SADLER *on his New Syſtem of* PRACTICAL ARITHMETIC.

SIR,

YOUR Treatiſe of *Arithmetic* is truly a very excellent performance, and I have, and ſhall recommend it as the moſt ingenious piece extant, in our language, upon the ſubject, and heartily wiſh you all the encouragement due to ſo meritorious an undertaking, and am Sir,

Your very humble Servant,

NATH. BROWNELL.

Coventry Mathematical
School, *Feb.* 4th, 1773.

To Mr. THOMAS SADLER, *on his New* ARITHMETICAL SYSTEM.

SIR,

I Greatly approve of your *Arithmetical Syſtem*, and if my recommendation of it ſhould be thought of any ſervice to you, it will afford me infinite pleaſure to declare my ſentiments to the world, of a work that in my opinion, juſtly entitles you to the thanks and applauſes of all perſons engaged in the inſtruction of youth, in ſo uſeful and neceſſary a branch of learning. I am Sir, wiſhing you ſucceſs,

Your humble Servant,
BENJAMIN WEST.

Weedon-Beck, in *Northamptonſhire*,
February 5th, 1773.

To Mr. THOMAS SADLER, *on his New and Ingenious Treatiſe of* PRACTICAL ARITHMETIC.

SIR,

YOUR laſt I receiv'd, together with the ſheets of your *Arithmetic*, I exceedingly like your plan of proceeding, as 'tis not only uſeful, but even very entertaining both to youth and thoſe of riper years. The whole of your work is handled in a maſterly manner, which doubt not will render it a favourable reception to the public; for my part, ſhall introduce it to my pupils as the beſt of the kind extant, and am, (wiſhing your ſucceſs in all your undertakings)

Sir, Your ſincere Friend,
and humble Servant,
WILLIAM GOUGH.

Elleſmere,
March 12th, 1773.

To

To the P U B L I C.

WE whose Names are hereunto subscribed, having perused the Plan of this ingenious Treatise of *Practical Arithmetic*, beg leave to recommend it as the most Instructive (as well as delightful) Book we have seen upon the subject, and think it worthy the greatest Encouragement from all *Ranks* and *Degrees* of People.

Edward Hamnet, Newhall,
William Eccleshall, Tarporley,
Charles Harding, Congleton,
Jonathan Worsencroft, Stockport,
Thomas Holland, Norbury,
} Philomath. } *Cheshire*.

Isaac Tarrat, Epsom, } Philomath. } *Surry*.
Gervas Adams, Alvaston, } Philomath. } *Derbyshire*.

Matthew Clemenson, *Richard Suddones*, *Joseph Becconsfield*,	Writing Master and Teacher of the Mathematics at	Chester, *Cheshire*.
John Pinnington,		Chetford, *Cheshire*.
Arthur Burns,		Tarporley, *Author* of Geodesia Imp'd. *Cheshire*.
Samuel Hodgkin,		Burwardsley *Cheshire*.
William Swift,		Stow near *Lincoln*,
John Salt,		W-hampton, *Staff*.
William Breese,		Adderley, *Shropshire*.
Humphry Davies,		Aston, *Shropshire*.

CONTENTS.

EXPLANATION of CHARACTERS.

Signs.	Names.		Significations.
$+$	*Plus* or *more.*	The Sign of	Addition as $5+4$ is 9.
$-$	*Minus* or *lefs.*	The Sign of	Subtraction as $8-3$ is 5.
$\times$	*Multiplied into or by*	The Sign of	Multiplication as 6×4 is 24.
$\div$	*Divide by*	The Sign of	Divifion as $12\div4$ is 3.
$=$	*Equal to*	The Sign of	Equality as $7+5=12$,

$:$ *Is to*, $::$ *So is* — The Signs of Proportionals as $6:9::12:18$.

$\surd$ *Extraction of the Roots* — The Square Root of 9 is $\sqrt[2]{9}=3$ and the Cube Root of 27 is $\sqrt[3]{27}=3$.

$\frac{\overline{8-3}\times4}{5}=4$. for 8 lefs 3 multiplied by 4 and divided by $5=4$.

NOTATION OF NUMBERS.

NOTATION teacheth to expreſs
Numbers in value, more or leſs;
Ten Characters will form complete,
What ſums you want tho' e'er ſo great.

NUMERATION TABLE.

								1	Unit.
							2	1	Tens.
						3	2	1	Hundreds.
					4	3	2	1	Thouſands.
				5	4	3	2	1	T. of Thouſands.
			6	5	4	3	2	1	C. of Thouſands.
		7	6	5	4	3	2	1	Millions.
	8	7	6	5	4	3	2	1	T. of Millions.
9	8	7	6	5	4	3	2	1	C. of Millions.

IN this Table each Figure from the place of Units, increaſeth in a tenfold proportion; as 1 in the firſt place is unit or one; 2 in the ſecond place, is two Tens or Twenty; 3 in the third place is three Hundred and ſo of the reſt.

When large Numbers are expreſſed by Figures, for the more eaſy reading of them; let them be divided from the right-hand towards the left into Periods, and half Periods, each Period to contain ſix Characters or Figures, then the firſt Period will be Units or Ones, the ſecond Millions, third Billions, fourth Trillions, fifth Quadrillions, and ſixth Quintillions, as below.

Note, the firſt half of any Period, are ſo many Units, the latter half ſo many Thouſands of

Quintillions.	Quadrillions.	Trillions.
th. *un.*	*th.* *un.*	*th.* *un.*
123, 456.	123, 456.	123, 466.
Billions.	Millions.	Units.
th. *un.*	*th.* *un.*	*c.x.t.* *h.t.u.*
123, 456.	123, 456.	123, 456.

To expreſs in Figures any Number propos'd in words, and to expreſs in words, any Numbers propos'd in Figures, obſerve to get by heart the following

RULE.

In Words when you've the given ſum,
Fix Cyphers and the anſwer'll come,
And when in Figures 'tis no more,
But count them from the Table o'er.

EXAMPLE I.

What is five in the fifth place, ſix in the ſixth place, ſeven in the ſeventh place, eight in the eight place, and nine in the ninth place of the Table?

By

By annexing Cyphers to each Number, according to their places in the Table, we have these given Numbers, Viz.

	50000	which Numbers being all wrote down, according to the places where they ſtand will be equal
	600000	
	7000000	
	80000000	
	900000000	
to	987650000	*i. e.* in words, nine Hun-

dred Eighty ſeven Million, ſix Hundred and fifty Thouſand.

Example 2.

Expreſs in Figures, Eighty Thouſand four Hundred and forty.

h. t. u.
80,000
400
40
80440

Example 3d.

How do you write down ſeventeen Millions, ſeventeen Thouſand, ſeventeen Hundred and ſeventeen?

$$\begin{array}{r} 17000000 \\ 17000 \\ 1700 \\ 17 \\ \hline 17018717 \\ \hline \end{array}$$

EXAMPLE 4.

Express in Figures forty-five Billions, four Hundred, forty-five Thousand and four Millions, sixty Thousand, six Hundred and fifteen.

$$\begin{array}{r} 45,000,000,000,000 \\ 445,004,000,000 \\ 60,000 \\ 600 \\ 15 \\ \hline 45,445,004,060,615 \\ \hline \end{array}$$

EXAMPLE 5.

Write down in Words, 34167. Begin at the right-hand in the place of Units, and count them as per Table, and they will be read thirty-four Thousand, one Hundred and sixty-seven.

Ex-

EXAMPLE 6.

Write in words 909090909. Anſwer. Nine Hundred and nine Millions, ninety Thouſand, nine Hundred and nine.

A SYNOPSIS of the ROMAN NOTATION.

1 =I
2 =II
3 =III
4 =IIII or IV.
5 =V
6 =VI
7 =VII
8 =VIII
9 =IX
10=X
11=XI
20=XX
30=XXX
40=XL
50=L
60=LX

70=LXX
80=LXXX
90=XC
100=C
500=D or Iↄ
1000=M or CIↄ
2000=MM
5000=Iↄↄ or $\overline{V}$
6000=$\overline{VI}$
10000=X or CCIↄↄ
50000=Iↄↄↄ
60000=$\overline{LX}$
100000=$\overline{C}$ or CCCIↄↄↄ
1000000=$\overline{M}$ or CCCCIↄↄↄↄ
2000000=$\overline{MM}$
&c.

ADDITION.

ADDITION teacheth us to find
The truth of Numbers when combin'd;
The Sum or Total to expreſs
Of any Numbers, great or leſs.

Firſt of Simple Numbers.

RULE.

As Numeration does direct
To place your Numbers, don't neglect;
Firſt to the right begin to count,
And you will find with eaſe th' amount.
Then underneath write down th' exceſs
Above what Tens it ſhall expreſs;
Which Tens add up with the next row
And through the whole you thus muſt go.

Let theſe Numbers be added together.

EXAMPLE 1.	EXAMPLE 2.	EXAMPLE 3.
1473	654134	890147
6541	16475	86941
743	3589	7416
89	467	54
52	65	145
14	7	36789
8912	674737	1021492

To

To add up the Sum of Example 1. Begin and ſay 4 and 2 are 6 and 9 is 15, then make a dot with the pen, and carry the overplus or exceſs to the next Figure, and ſay 5 and 3 are 8 and 1 is 9 and 3 is 12, make a dot, and write the exceſs above 10 in the place of Units, under the firſt line, and carry the two dots or tens to the ſecond row, and ſay 2 and 1 are 3 and 5 is 8, and 8 is 16 make a dot for the ten, and ſay 6 and 4 are 10, make a dot, and ſay 4 and 7 are 11, write down the overplus 1 under the ſecond line or row, and carry the three dots or tens to the third row and ſay 3 and 7 are 10 make a dot, then 5 and 4 make 9, which write under the third row, carrying 1 dot, or 10 to 6 makes 7 and 1 is 8, which write down under the fourth row, then the whole ſum of the Numbers given in Example 1 makes 8912; in words, eight Thouſand nine Hundred and twelve.

Some Arithmeticians who have made a little progreſs in Numbers, perhaps may object to the above method of pricking off the tens &c. and explode it, but Mr. Emerson and the moſt celebrated Authors recommend it as a very ſure method for beginners, whether in Simple or Compound Numbers.

When the learner has got a little knowledge of what he is about, 'twill be found very eaſy to proceed in the following manner as by Example 2. Say 7 and 5 are 12, and 7 is 19 and 9 is 28 and 5 is 33 and 4 is 37. now there being 7 above 3 tens, write down the exceſs in the place of Units, and carry 3 to the ſecond row ſaying 3 and 6 are 9. and 6 is 15 and 8 is 23 and 7 is 30 and 3 is 33 write down 3 under the ſecond row and carry 3 to the third row, ſaying 3 and 4 are 7 and 5 is 12 and 4 is 16 and 1 is 17, write down 7 and carry 1 to the fourth row, then ſay 1 and 3 are 4, and 6 is 10 and 4 makes 14. write down the exceſs and carry 1 to the fith row, ſaying 1 and 1 are 2 and 5 is 7 write down 7 under this row, then 6 only re-

remaining in the ſixth row write that down in its proper place, Unit them up according to your Numeration Table, and they will be ſix Hundred, ſeventy-four Thouſand, ſeven Hundred and thirty-ſeven. By either of the above methods proceed to add up the other Example, and you will have the ſum as there underneath it is.

The beſt way to prove Addition is by beginning at the top and adding up all the Numbers downwards, the ſame as you did upwards; if both ſums agree the Work is undoubtedly right.

Example 4.	Example 5.
967891	1234567
234567	8901234
891456	5678901
789012	2345678
345678	9012345
	4567890
3228604	31740615

Example 6.

I was born in the Year 1730, when ſhall I be 64 Years of Age?

This is no more than to 1730
Add 64

And we have the Year required 1794

Ex.

EXAMPLE 7.

A Gentleman had in his Nurſery one Million of Oak, one Hundred Thouſand Aſh, and one Hundred Fruit Trees, and alſo fifty-nine Elm and Lime Trees; I demand how many Trees were growing in the Nurſery?

Oaks - -	1000000
Aſh - -	100000
Fruit - - -	100
Elm &c - -	59
Anſwer	1100159 Trees in all.

EXAMPLE 8.

In ſeventeen Hundred, ſixty and ſix,
A Lady was born whoſe age I would fix;
To be twenty Years I'd have her no more,
But join her in bands, at th' age of one ſcore,
Then tell me TYRO, what Year this will be,
'Twill pleaſe th' dear Charmer, no doubt and pleaſe thee?

To	1766
Add	20
Anſwer	1786 the year required.

Ex.

EXAMPLE 9.

A Tree being cut into four parts, each part being meaſured contained 20, 25, 30 and 37 Solid Feet. What was the content of the whole Tree?

Place the Numbers under each other, thus.

$$\begin{array}{r} 20 \\ 25 \\ 30 \\ 37 \\ \hline \end{array}$$

Anſwer 112 Solid feet.

EXAMPLE 10.

A Gentleman being upon his Travels rode through ſix market Towns A, B, C, D, E, F, in one day, ſetting out of the Town A and lying in the Town F all Night, found the diſtance from A to B 17 miles, from B to C 10, from C to D 16, from D to E 7, and from E to F 8 miles. I demand the miles travelled by the Gentleman that day?

$$\text{From}\left.\begin{array}{c} A \\ B \\ C \\ D \\ E \end{array}\right\}\text{to}\left\{\begin{array}{lr} & \text{Miles.} \\ B\text{ - - } & 17 \\ C\text{ - - } & 10 \\ D\text{ - - } & 16 \\ E\text{ - - } & 7 \\ F\text{ - - } & 8 \\ \hline \end{array}\right.$$

Anſwer 58

Ex.

EXAMPLE 11.

Cyrus King of Persia dyed in the year of the World 3479; when *Cambyses* succeeded, and reigned 8 Years; *Darius Hystaspes* 36 Years; *Xerxes* 21 Years; *Artaxerxes Longimanus* 41 Years; *Darius Nothus* 19 Years; *Artaxerxes Mnemon* 46 Years; *Artaxerxes Ochus* 21 Years; *Arogus* 2 Years, and *Darius Cadomanus* 4 Years. Required the Year of the World when this last Monarch dyed?

To find the whole period of this Persian Monarchy, write down the Year *Cyrus* dyed, and each succeeding reign under, which added together Answers the conditions required.

Cyrus dyed in the year of the World - -	3479	Years.
Cambyses reigned - - -	8	
Darius Hystaspes - -	36	
Xerxes - - - -	21	
Artaxerxes Longimanus -	41	
Darius Nothus - - -	19	
Artaxerxes Mnemon - -	46	
Artaxerxes Ochus - -	21	
Arogus - - - - - -	2	
Darius Cadomanus - -	4	
Answer	3677	

EXAMPLE 12.

Decypher the following numerical Roman Characters, and find their sum Viz. DLXXXI; CCIↃↃCCXLII; CCCCIↃↃↃↃ; DC; MCCXXX; MDXXIV; DCIX; CCCIↃↃↃ CCXC and DCCLIX.

From

From the Roman Notation write down the value thus. — 581

10242	By the help of the
1000000	Roman Characters
600	many curious and a-
1230	musing Paradoxical
1524	questions have been
609	proposed and An-
100290	swered.
759	
Answer 1115835	

AMUSING QUESTIONS &c.

A Paradoxical Question.

Into my House, came neighbour *John*,
With three legs and a wooden one;
If one was taken from the Swain,
Just five ye wits would then remain.

Solution.

According to the Roman notation the number of legs are *IV*. = 4. then by taking away the *I* only the *V* remaining makes 5. which answers the conditions required.

An.

Another by Mr. *Samuel Hammond*, in Ladies Diary for 1760.

In only *one*, I'll prove there's *none*,
  In *ſeven*, *five*, no more;
But (without tricks) there's *nine* in *ſix*,
  Altho' in *five* but *four*.
What I've above, propos'd to prove,
  Is literally true,
And hope next year, ye artiſts rare,
  'Twill be reſolv'd by you.

Anſwer'd in the then next year's Diary, viz. 1761, by *T. Sadler*, thus

In *One* a *Cypher* Sir I ſee, *O.*
In *ſeVen*, *five* I muſt confeſs, *V.*
In *ſIX* there's *nine* all muſt agree, *IX.*
In *ſIVe* there's *four* nor more nor leſs. *IV.*

TABLES of the moſt common Coins Weights and Meaſures, uſed in *Great Britain.*

First of *Engliſh Money.*

Farthings. f.	Pence. d.	Shillings. s.	Pounds. l.
4	1		
48	12	1	
960	240	20	1

SCHOLIUM.

The ſoregoing Table and the ſucceeding ones are explained in the following Manner, the words at Top expreſs the Names of all the numbers below them, with the Character under each Word, and are to be read, or learned by Heart thus; 4 farthings equal to 1 penny. 48 farthings 12 pence or 1 ſhilling. 960 farthings, 240 pence, 20 ſhillings equal to 1 pound. $\frac{1}{4}$ denotes 1 farthing, or 1 fourth of a penny, $\frac{1}{2}$ denotes 2 farthings, or 1 half of a penny; $\frac{3}{4}$ denotes 3 farthings, or 3 fourths of a penny. 4 pence is 1 groat, 6 pence 1 teſter, 5 ſhillings 1 crown, 6 ſhillings and 8 pence 1 noble, 10 ſhillings one angel, 13 ſhillings and 4 pence 1 mark.

TROY WEIGHT.

Grains. gr.	Pennyweights. dw.	Ounces. oz.	Pound. lb.
24	1		
480	20	1	
5760	240	12	1

The celebrated Mr. *Malcolm*, in his laborious Syſtem of Arithmetic page 74, ſays "That the Original of all Weights in *England* was a Corn of "Wheat, taken out of the middle of the Ear and "well dried; of which 32 made one Penny Weight, "inſtead of which, they made afterwards another "Diviſion of the Pennyweight into 24 Grains."

Mr.

Mr. *Ward* (in his Young Mathematicians Guide) cites a Statute of *Edward* III. by which there ought to be no Weight used but Troy, " but Custom" (says he) " afterwards prevailed in giving larger Weight " to coarse and Drossy Commodities, and thereby " introduced the Weight called Averdupoise," and as to the proportion betwixt Troy and Averdupoise Weight, he says, " that by a very nice Experiment " he found that one pound Averdupoise, is equal to " 14 Ounces 11 Penny Weights 15 $\frac{1}{2}$ Grains Troy " So that neither the Ounce nor Pound are the same.

By *Troy Weight* are weighed Jewels, Gold, Silver, Corn, Bread and Liquors.

APOTHECARIES WEIGHT.

Grains. gr.	Scruples. scr.	Drams. dr.	Ounces. oz.	Pounds. lb.
20	1			
60	3	1		
480	24	8	1	
5760	288	96	12	1

Apothecaries is the same as *Troy Weight*, and is so called because the *Apothecaries Druggists* &c. compound their Medicines by it, but they buy and sell their Drugs by *Averdupoise Weight*.

AVER-

AVERDUPOISE WEIGHT.

Drams. dr.	Ounces. oz.				
16	1	Pounds. lb.			
256	16	1	Quarters. qr.		
7168	448	28	1	Hundreds. C.	
28672	1792	112	4	1	Tons. T.
573440	35840	2240	80	20	1

Grocery and chandlers wares, and all metals, except *gold* and *filver*, are weighed by this weight, according to Mr. *Malcolm*, fheeps wool weight has thefe denominations, 7 pounds = 1 clove, 2 cloves = 1 ftone = 14 pounds, (but in *Scotland* and many places in *England*, 16 pounds are reckoned to the ftone,) 2 ftones = 1 tod, 6 $\frac{1}{2}$ tods = 1 wey, 2 weys = 1 fack; 12 facks = 1 laft.

LONG

LONG MEASURE.

Inches. In.	Feet. F.	Yards. Yd.	Poles. Pls.	Furlongs. F.	Miles. M.
12	1				
36	3	1			
198	16½	5½	1		
7920	660	220	40	1	
63360	5280	1760	320	8	1

In Long Meaſure, (according to the ſtatutes of 33 *Edward* I. and 25 *Elizabeth*,) a barley corn is the leaſt meaſure, whereof 3 taken out of the middle of an ear of corn, and well dried are 1 inch, 4 inches = 1 hand, 6 feet = 1 fathom, 3 miles = 1 league, 60 nautical or geographical miles 1 degree, or according to Mr *Norwood's* meaſure, 69½ miles make 1 degree; 360 degrees, or 25000 miles nearly, is the circumference of the earth.

CLOTH MEASURE.

Inches. In.	Nails. Na.		
$2\frac{1}{4}$	1	Quarters. Qr.	
9	4	1	Yards. Yd.
36	16	4	1

1 Ell { Flemish 3 qrs.
English 5
French 6
Scotch $4\frac{1}{3}$ inch.

SQUARE

SQUARE or LAND MEASURE.

Square Inch. Sq. In.	Sqr. Feet. Sq. Ft.	Sqr. Yds. Sq. Ys.	Sqr. Poles Sq. Pls.	Roods. Rds.	Acres. Acr.
144	1				
1296	9	1			
39204	272¼	30¼	1		
1568160	10890	1210	40	1	
6272640	43560	4840	160	4	1

10 chains (*per Gunter*) in length, and 1 in breadth, are an acre of land = 4840 yards.

WINE

WINE MEASURE.

Pints. pts.	Gallons. gal.	Tierces. tier.	Hhds. hd.	Punch. pu.	Pipe or Butt. pipe.	Tun. t.
8	1					
336	42	1				
504	63	$1\frac{1}{2}$	1			
672	84	2	$1\frac{1}{3}$	1		
1008	126	3	2	$1\frac{1}{2}$	1	
2016	252	6	4	3	2	1

Wines, brandies, fpirits. perry, cyder, mead, vinegar, oil and honey, are meafured by this meafure. A gallon = 231 folid inches, an anchor = 10 gallons, a rundlet = 18 gallons, a barrel = $31\frac{1}{2}$ gallons. Mr. *Ward* was witnefs to an experiment tried at *Guild-Hall* before the *Lord Mayor* &c. when the old ftandard wine gallon was found to contain exactly but 224 cubical inches, yet for all that the fuppofed content of 231 inches are continued.

ALE AND BEER MEASURE.

Pints. pts.	Gallons. gal.				
8	1	Firkins. fir.			
68	8½	1	Kilderkin. kild.		
136	17	2	1	Barrels. bar.	
272	34	4	2	1	Hhds. hds.
408	51	6	3	1½	1

1 ale gallon = 282 cubic inches. The ale firkin in *London* contains 8 gallons, and the beer firkin 9. But in other places in *England* it is (by a ftatute of excife made in the year 1689) 8½ gallons to the firkin.

DRY MEASURE.

Pints. pts.	Gall. gall.	Pecks. pks.	Bushels. bu.	Combs. cbs.	Quar. qr.	Weys. w.	Last. l.
8	1						
16	2	1					
64	8	4	1				
256	32	16	4	1			
512	64	32	8	2	1		
2560	320	100	40	10	5	1	
5120	640	320	80	20	10	2	1

A gallon dry measure contains $268\frac{4}{5}$ cubic inches at *London*, 36 bushels of coals make a chaldron. A bushel water measure is 5 pecks. All dry wares such as corn, seeds, fruits, roots, sand, salt, coals, oisters, muscles, cockles, &c. are measured by this measure.

TIME.

Minutes. min	Hours. ho.			
60	1	Days. dy.		
1440	24	1	Weeks. wk.	
10080	168	7	1	Months. mo.
40320	672	28	4	1

Of MOTION.

Mark'd thus T. S. M. D. S. (‴ ″ ′ ° s)
60 Thirds make 1 second″,
60 Seconds 1 minute′,
60 Minutes 1 degree°,
30 Degrees 1 sign of the zodiac.

COM-

COMPOUND ADDITION.

To add up numbers of ſeveral denominations together, obſerve the following

RULE.

Let all your numbers placed be,
In form and order to agree;
Pounds under pounds, the reſt ſo name,
Of weights and meaſures do the ſame.

Before we proceed to work any examples, it will be neceſſary to get by heart the following

PENCE TABLES.

d.		s.	d.
20	are	1	8
30		2	6
40		3	4
50		4	2
60		5	0
70		5	10
80		6	8
90		7	6
100		8	4
110		9	2
120		10	0

s.		d.
2	are	24
3		36
4		48
5		60
6		72
7		84
8		96
9		108
10		120
11		132
12		144

Add these Sums of Money together.

Example 1.			Example 2.		
£.	s.	d.	£.	s.	d.
	(20)	(12) (4)			
1	16.	4.	41	14	5 $\frac{3}{4}$
12	10	9 $\frac{1}{4}$.	86	18	11 $\frac{1}{4}$
341	16.	4.	51	19	4 $\frac{1}{2}$
9.	10.	11. $\frac{3}{4}$	67	17	7 $\frac{3}{4}$
18.	15	8	12	12	3 $\frac{1}{4}$
384	10	1	261	2	8 $\frac{1}{2}$

To add up Example 1. Begin and say 3 and 1 is * 4, make a dot and carry 1 to the next denomination, saying, 1 and 8 is 9 and 11 is 20, make a dot and carry the overplus above 12, to wit 8, to the next figure, saying, 8 and 4 is 12, make a dot and say, 9 and 4 is 13, which is 1 above 12, therefore make a dot and write down 1, and carry the three pricks or dots to the next denomination, and say, 3 and 15 is 18, and 10 is 28, make a dot and carry the excess above 20, to wit, 8 to the next figure, saying 8 and 16 is 24, make a dot, then say 4 and 10 is 14, and 16 is 30, make a dot, and write down the excess 10 under its own line, and carry 3 (the number of dots) to the place of pounds, and say, 3 and 8 is 11, make a dot, and say, 1 and 9 is 10, make a dot, then 1 and 2 is 3 and 1 is 4, which write under its own line, and carry the 10 or dots to the next row. Saying, 2 and 1 is 3 and 4 is 7 and 1 is 8, write down 8 at the bottom of the line, then 3 remains in the third

* See the marginal notes in Multiplication.

third row, which write down in the third place, and the sum total is, three hundred and eighty four pounds, ten shillings and one penny.

The above method being so easy to be understood, I shall now proceed to shew the learner how to add up such sums by a more expeditious method, and for that purpose, take Example 2. and say, 1 and 3 is 4, and 2 is 6 and 1 is 7 and 3 make 10; 10 farthings is two pence halfpenny, set down the halfpenny thus ½ and carry the two pence to the pence row, saying, 2 and 3 is 5, and 7 is 12 and 4 is 16 and 11 is 27 and 5 is 32, then say, 30 pence is 2 shillings and 6 pence, and 2 pence is 2 shillings and 8 pence, set down 8 and carry 2; and proceed to the shillings and say, 2 and 2 is 4, and 7 is 11, and 9 is 20 and 8 is 28 and 4 is 32 (which is 2 above 3 tens) set down the 2 and go on to the next row (which is composed of a number of *ones* being so many *ten shillings*, as you may see by their being placed or set in the *place of tens*) and (therefore) carry the 3 tens thereto, and say, 3 and 1 is 4 and 1 is 5 and 1 is 6 and 1 is 7 and 1 is 8, eight ten shillings make 4 pounds, which carry to the place of pounds, and say, 4 and 2 is 6 and 7 is 13 and 1 is 14 and 6 is 20 and 1 is 21, write down 1, and carry 2 saying, 2 and 1 is 3 and 6 is 9, and 5 is 14, and 8 is 22 and 4 is 26, which write down and the total will be two hundred and sixty one pounds, two shillings and eight pence halfpenny, in the same manner proceed with the following examples, or any other of the like kind or sort.

EXAMPLE

EXAMPLE 3.			EXAMPLE 4.			EXAMPLE 5.		
£.	s.	d.	£.	s.	d.	£.	s.	d.
941	12	1 ¼	12345	14	¼	51	14	5 ¼
345	16	5 ¾	1234	16	1 ¾	65	13	9 ¾
678	19	4 ¼	123	-	3 ¼	78	18	8 ½
900	14	5 ½	12	14	-	90	10	5 ¾
571	13	3 ¼	1	13	11 ¾	12	14	10 ¼
						34	13	3 ¾
3438	15	8	13717	18	5	12	12	2 ¼
						346	17	9 ½

EXAMPLE 6.

		£.	s.	d.
Received of	Mr. *East*	41	11	-
	Mr. *West*	9	16	4
	Mr. *North*	6	17	9 ½
	Mr. *South*	8	11	2
Receiv'd in all		£.66	16	3 ½

EXAMPLE 7.

A Tradesman received in cash of *A.* 4l. 1s. 4d. of *B.* 13l. 14s. 5d. ½ of *C.* 81l. 16s. 8d. of *D.* 94l. 10s. 9d. ½ of *E.* 5l. 16. 8d. and of F. 51l. 0s. 8d. ¾ What was the sum receiv'd?

		£	s.	d.
Received of	*A.*	4	1	4
	B.	13	14	5 ½
	C.	81	16	8
	D.	94	10	9 ½
	E.	5	16	8
	F.	51	-	8 ¾
Receiv'd in all		£.251	-	7 ¾

EXAMPLE 8.

Zebedee owes his brother *Ambroſe* fourteen ſhillings and nine pence halfpenny, his brother *Thomas* twenty five ſhillings and four pence, his brother *Joſeph* ſixteen ſhillings and three farthings, his ſiſter *Mary* one pound ſeven groats, and two-pence, and to his neighbour *Owen*, a noble. How much does he owe in all?

		£.	s.	d.
Due to	*Ambroſe*		14	9 ½
	Thomas	1	5	4
	Joſeph		16	¾
	Mary	1	2	6
	Owen		6	8
Anſwer		£.4	5	4 ¼

EXAMPLE 9.

Old SIMON aged ninety two,
At laſt did bid this world adieu,
Some mouldy pelf he left behind,
Which oft diſturb'd his craving mind.
Four ſons he had, and each now claims
His ſhare, *John*, *Simon*, *Ralph*, and *James*;
His wife b'ing dead, he'd daughters three,
Call'd *Suſan*, *Ruth*, and *Margery*.
His will b'ing read, *young Simon* found,
He muſt receive *three hundred pound*,
Juſt *eight ſcore pounds* too was *Ralph's* part,
But *John* he bore an aching heart,
And of his fortune was beguil'd,
Becauſe he'd got their maid with child.

One

One shilling only was his share,
But *James* it seems had better fare,
Of cash in *pounds six score* had he,
And *Susan's* part was *ninety three*;
But *Ruth* unlucky girl had ran
Away with *Joe* the servant man,
And for the hasty crime she'd done,
Was cut off just the same as *John*;
But *Marg'ry's* share amongst the rest,
By calculation prov'd the best,
For by the father's will we find,
The chest which SIMON left behind
Had store of pelf,—the treasure found,
Amounted to *four hundred pound*:
Of clothes and goods it did appear,
Just *thirty pound* was made out clear,
All this was left to *Madge* because,
She had obey'd her father's laws.
Now Tyro you with ease may find,
The fortune SIMON left behind.

To answer this Example, is no more than to write down each one's fortune as under, and add them together.

		£.	s.	d.
Simon's	share	300	–	–
Ralph's	share	160	–	–
John's	share	–	1	–
James's	share	120	–	–
Susan's	share	93	–	–
Ruth's	share	–	1	–
Marg'ry's	share	430	–	–
Sum left		£.1103	2	–

EXAMPLE 10.

A houſe keeper had diſburs'd for her lady, in marketting, (per memorandum book,) for *beef*, ten ſhillings and five pence halfpenny, *mutton*, ſeven ſhillings and eight pence, *veal*, five ſhillings and three pence farthing, *chickens*, nine groats, and for *eggs*, ſeven farthings. What was the ſum diſburſt ?

			s.	*d.*
Beef	-	-	10	5 ½
Mutton	-	-	7	8
Veal	-	-	5	3 ¼
Chickens	-	-	3	–
Eggs	-	-		1 ¾
		Sum £.1	6	6 ½

EXAMPLE 11.

Frank Guzzle, *Belch*, and *Soaking Dan*,
Muſt have a bottle with Sir *John*, *
And topers like with TROT † prevail,
To fill a jug of nappy ale.
A jug ! a mighty jug indeed,
A yard about was fill'd with ſpeed;
Ten quarts it held, as neighbours tell,
Which pleas'd the *Landlord* mighty well.
Three times b'ing fill'd the topers they,
Cou'd ſcarce conduct themſelves away,
But paid the ſcore which pleaſed TROT,
To think what cuſtomers he'd got,
'Twas *fifty pence* a piece the ſhot,
What was the whole young Tyro tell;
Which pleas'd the *Landlord* TROT ſo well?

By

* *Sir John Barleycorn* † *The Landlord.*

By pence *Table* 50 pence is 4*s.* - 2*d.* which write down three times thus.

	£.	s.	d.
Frank Guzzle - -	–	4	2
Belch - -	–	4	2
Soaking Dan - -	–	4	2
The sum spent	–	12	6

EXAMPLE 12.

A Farmer's bill, upon his Labourer.

Roger Furber,

1770. To *John Simon.* *Dr.*

	£.	s.	d.
May 30 : To a measure of Corn	–	5	8
June 8 : Ditto -	–	6	3
24 : Ditto -	–	7	–
30 : A bushel of Oats	–	2	6
July 1 : A load of Coals	–	16	–
12 : Beef - -	–	4	4
18 : Butter -	–	1	6 ½
Total	£. 2	3	3 ½

An

EXAMPLE 13.

An Assessment for the Highway Levy or Ley, in the Township of N—— and Parish of M——— in the County of *Chester*, rated at 3*d* per pound, from *Michaelmas* 1769, to *Michaelmas* 1770.

		£.	s.	d.
Sir *Ambrose Longbutts*, Bart.		2	4	8 ½
Sampson Gripe Esq.	—	1	3	11
Isaac Tarrat	— —	1	7	9 ½
Samuel Bentley	—	2	1	1
William Swift	—	1	8	4
James Brown	—	2	3	1 ½
Charles Hutton	—	3	–	4 ½
Teresa Phillips	—	1	10	5
Anne Nicholls	—	2	15	11 ½
Benjamin West	—	2	1	–
Thomas Baker	—	1	4	11
Patrick O'Cavannah	—	1	15	10 ½
Arthur Burns	—	2	3	7
Edward Hamnet	—	1	4	1 ½
William Breeze	—	1	14	9
Thomas Weaver	—	–	18	10 ½
Samuel Hodgkin	—	–	16	11
Thomas Holland	—	–	4	5 ½
William Gough	—	2	3	4
Robert Langley	—	3	14	11 ½
		£.35	18	6

EXAM-

EXAMPLE 14.

A *Gentleman* gave orders to an *Auctioneer*, to sell him the following farms or tenements. What is the sum total of their yearly rent?

Tenants Names		*Rent per Ann.*		
		£.	s.	d.
Jeffery Blake	— —	27	5	–
Thomas Jenkin	—	15	15	–
John Fisher	— —	12	12	–
Ambrose Sadler	—	40	–	–
Zebedee Sadler	—	7	10	–
Thomas Sadler	—	5	10	–
Joseph Sadler	—	4	10	–
Stephen Gibbons	—	3	15	–
William Podmore	—	1	16	6
Ralph Ireton	— —	1	10	–
Job Bate	— —	1	17	–
Guy Cobb	— —	1	18	6
John Knowles	— —	1	1	–
Answer		£ 125	–	–

TROY

Troy Weight.

A *Lady* of fortune being desirous of furnishing herself with houshold plate, went to a Silver-smith and bought *dishes* to the weight of 20 lb. 10 oz. 18 dwt. and 21 grs. *plates* 37 lb. 19 dwt. and 14 gr. *spoons* 8 lb. 9 oz. and 4 dwt. *salts* 3 lb. 15 dwt. and 19 gr. a *tankard* and *cup* 5 lb. 11 oz. and 14 dwt. and also three *waiters* 12 lb. and 23 gr. What weight of plate did she buy in all?

Write down the weight of each quantity under each other, and add them up as in addition of Money, only take care to point or dot, according to the table pertaining to this weight in page 14 and as you see express'd at the top of each denomination in this example.

		(12) lb.	(20) oz.	(24) dwt.	gr.
Dishes	-	20	10	18	21.
Plates	-	37	–	19	14.
Spoons	-	8	9	4	–
Salts	-	3	–	15	19.
Tankard &c.		5	11	14	–
Waiters	-	12	–	–	23
		87	9	13	5

Note, you may work this example and all others of the kind without dotting, (except at the grains) for the *penny weights* are to be work'd the same as *shillings*, the *ounces* as *pence*, and the *pounds* as *integers*.

Apo-

Apothecaries Weight.

An *Apothecary* made a compoſition of 6 ingredients, the weight of the 1ſt. was 12 lb. 6 oz. 4 dr. 1 ſcr. and 13 gr. the 2d. 8 lb. 4 oz. 5 dr. 2 ſcr. and 14 gr. the 3d. 9 lb. 1 ſcr. and 16 gr. the 4th. 14 lb. 3 oz. and 1 dr. the 5th. 6 lb. 11 oz. 4 dr. 2 ſcr. and 17 gr. and the 6th. 11 lb. 2 ſcr. 5 gr. What was the weight of the whole?

		(12)	(8)	(3)	(20)
No.	lb.	oz.	dr.	ſcr.	gr.
1	12	6	4.	1	13
2	8	4	5	2.	14
3	9	-	-	1	16
4	14	3	1.	-	-
5	6	11	4	2.	17
6	11	-	-	2.	5
Anſ.	62	2	1	2	5

Note, the *grains* are caſt up as ſhillings, and the *ounces* as pence.

Averdupoize Weight.

A Country ſhopkeeper bought of a Tradeſman in *London*, *Sugars* weighing 4 c. 3 qrs. and 9 lb. *Raiſins* 2 c. 1 qr. and 21 lb. *Teas* 1 c. and 3 qrs. *Coffee* 3 qr. and 19 lb. and *Spices* 1 c. and 12 lb. What was the whole weight?

		(4)	(28)
	c.	qr.	lb.
Sugars -	4	3	9.
Raiſins -	2	1	21
Teas -	1	3	-
Coffee -	-	3	19.
Spices -	1	-	12
Anſwer	11	-	5

N. B. No occaſion for dotting at the *quarters*, they being caſt up as tho' they were farthings.

A

A Stocking Weaver bought 6 bales of silk containing, (*viz.*)

		(16)	(16)
N°.	lb.	oz.	dr.
1	5	10.	12.
2	2	8	14.
3	3	4	15.
4	6	14.	12.
5	5	15.	8
6	1	2	3
Answer	25	9	–

LONG MEASURE.

A Turnpike Surveyor measures upon the road, from *A* to *B* 6 miles, 4 furlongs 15 poles, from *B* to *C* 4 miles, 7 furlongs, 30 poles, from *C* to *D* 10 miles, 20 poles, from *D* to *E* 9 miles, 6 furlongs, 12 poles, and from *E* to *F* 12 miles 2 furlongs 15 poles. What is the distance betwixt *A* and *F*?

			(8)	(40)
		m.	fur.	pls.
From *A*	to *B*	6	4	15.
B	*C*	4	7.	30
C	*D*	10	–	20.
D	*E*	9	6.	12
E	*F*	12	2	15
Answer		43	5	12

Note, there is no need to dot when adding up *poles*, for they are only as tho' they were two rows of figures the first *integers*, and the second *farthings*, but that I may not leave the learner under the least difficulty (of which I shall always be as careful as possible) let me further explain my meaning, by shewing how to add

The diſtance from 4 ſtatues, *A B C D* being meaſured along a walk to an obeliſk in a nobleman's garden, was found to be as follows to wit, from *A* to *B* 140 yards, 2 feet, 11 inches. *B* to *C* 134 yards, 1 foot, 9 inches. *C* to *D* 151 yards, 4 inches. and from *D* to the obeliſk 108 yards, 2 feet, 8 inches. What was the whole diſtance?

					(3)	(12)
				yds.	ft.	inch.
From	*A*	to	*B*	140	2.	11
	B		*C*	134	1	9
	C		*D*	151	–	4
	D		ob.	108	2.	8
Anſwer				535	1	8

Note, *inches* are caſt up in the ſame manner as *pence*.

---

add up the *poles* in this example, to do which, ſay 5 and 2 is 7 and 5 is 12, ſet down 2 and carry 1, and ſay, 1 and 1 is 2 and 1 is 3 and 2 is 5 and 3 is 8 and 1 is 9; 9 *quarter poles* is 2 *furlongs* and 1 quarter, the ſame as 9 farthings is 2 pence farthing, therefore ſet down 1, and the ſum is 2 furlongs and 12 poles, the ſame as if you had dotted, then carry the 2 furlongs to the row of furlongs, and proceed to work the queſtion.

Cloth Measure.

A *draper* at a Fair bought 5 pieces of cloth, each piece containing as follows, viz.

N°.	yds.	(4) qr.	(4) nls.
1 ——	35	3	3
2 ——	46	1	2
3 ——	21	3	1
4 ——	47	1	3
5 ——	19	2	1
Anſwer	171	-	2

The learner may obſerve that *nails* and *quarters* are caſt up the ſame as *farthings*.

Land Measure.

A *farmer* rents 4 pieces of land containing.

	ac.	(4) ro.	(40) pls.
In one field	16	1	24
In another	24	3	14
In another	21	1	12
In another	13	1	34
Anſwer	75	3	34

To caſt up *poles* without dotting you have directions in the preceding page, and the *roods* are added up as though they were *farthings*.

WINE MEASURE.

A *nobleman* bought of a *wine merchant*, the following ſorts and quantities of wine *viz. port* 1 tun 1 hogſhead and 36 gallons, *claret* 2 hogſheads 49 gallons, *mountain* 2 hogſheads 30 gallons and 4 pints, and *liſbon* 3 hogſheads 7 pints. How much did he buy in all?

	(4) tu.	(63) hhd.	(8) gal.	pts.
Port	1	1	36	–
Claret	–	2	49	–
Mountain	–	2	30	4
Liſbon	–	3	–	7
Anſwer	3	1	53	3

Hogſheads are caſt up the ſame as *farthings*.

ALE *and* BEER MEASURE.

A *London brewer* ſent into the country, ale and beer as follows, viz. at one time 4 hogſheads 19 gallons, at another 3 hogſheads 15 gallons, at another 12 hogſheads 24 gallons, at another 5 hogſheads 19 gallons, and at another 8 hogſheads 5 gallons. How much was ſent out in all?

			hhds.	(51) gal.
Delivered the	1ſt.	time	4	19
	2d.		3	15
	3d.		12	24
	4th.		5	19
	5th.		8	5
		Anſwer	33	31

Dry Measure.

A *cornfactor* delivers out of his granary the following quantities of corn, *to wit*, *wheat* 7 quarters 1 comb 3 bushels and 2 pecks, *rye* 5 quarters 1 comb 2 bushels and 1 peck, *oats* 4 quarters 1 bushel and 3 pecks, and *barley* 3 quarters 1 comb and 3 bushels. What was deliver'd in all?

	qr.	(2) com.	(4) bu.	(4) pks.
Wheat	7	1	3	2
Rye	5	1	2	1
Oats	4	–	1	3
Barley	3	1	3	–
Answer	21	1	2	2

The *pecks* and *bushels* are cast up like *farthings*, and the *combs* like halfpence.

Time.

A certain person had 4 sons, *Ralph*, *John*, *James*, and *Andrew*, when *John* was born, *Ralph's* age was 2 years 4 months 1 week and 3 days, when *James* was born, *John's* was 3 years 5 months 3 weeks and 4 days, and when *Andrew* was born *James's* age was 4 years 9 months 1 week and 5 days. How old was *Ralph* (the eldest son) when *Andrew* (the youngest) was born?

				(12) y.	(4) m.	(7) w.	d.
Ralph's	age when	*John*	was born	2	4	1	3
John's	age when	*James*	was born	3	5	3	4
James's	age when	*Andrew*	was born	4	9	1	5
			Answer	10	7	2	5

Here you see that *weeks* are to be added up in the same manner as *farthings*, and *months* in the same manner as *pence*.

Pro-

PROMISCUOUS QUESTIONS,

Selected from the best authors, for the exercise of the learner, with the *name* of the *author* prefixed to his performance.

Question 1. From Mr. *Vyse's* Arithmetic, *page* 30.

A person said he had 20 children, and that it happen'd there was a year and a half between each of their ages, his eldest was born when he was 24 years old, and the age of the youngest is now 21. What was the father's age?

	years
Father's age when the eldest child was born	24
19 Children allowing 1 year ½ between each	$28\frac{1}{2}$
The age of the youngest child	21
The age of the father	$73\frac{1}{2}$

Question 2. By the celebated Mr. *Emerson*;* see his Arithmetic *page* 189.

Three companies of soldiers passing by a shepherd the first takes half his flock and half a sheep, the se-

Note, when the learner is thoroughly acquainted with the rule of *Reduction*, it will then *plainly* appear to him, that there will be no need to point or dot in casting up any sum in addition of what kind soever, and which will be far preferable than dotting, as no dots or blots ought to be made (if possible to be avoided) amongst writing or figures.

* Mr. *Emerson* solves this question by *double position*.

cond takes half the remainder and half a ſheep, the third takes half the laſt remainder and half a ſheep, after which the ſhepherd had 20 remaining. How many had he at firſt? It is evident by the queſtion the ſhepherd had taken from him at the 3 different times 21, 42, and 84, to which add 20 remaining the ſum will be 167 the anſwer required.

A Paradoxical Queſtion extracted from the *Royal Magazine.*

A gentleman dying left his executor a ſum not amounting to 2000l. to be ſo divided amongſt his relations, that his *father* and *mother* his *ſon* and his *grandſon*, his *brother* and his *daughter*, ſhould each receive a ſum not leſs than 666l. 13s. 3d. *Quere* the ſcheme of kindred and exact ſum left?

SOLUTION.

Suppoſe two widows *A* and *B* no kin to each other, to be left each with a ſon, and that *A's* ſon marries *B*, and *B's* ſon marries *A*, and that *A's* ſon has a ſon by *B*, this is the ſcheme of kindred. *Note*, *A's* ſon is the gentleman that leaves the money, and for finding the exact ſum left, proceed thus

	£.	s.	d.
To his *father* who in this caſe is the ſame as his *ſon*.	666	13	3
To his *mother* who in the ſame manner is his *daughter*.	666	13	3
To his *grandſon* likewiſe who is the ſame as his *brother*.	666	13	3
Sum left	1999	19	9

The

The learner now being ſuppoſed to be ſufficiently taught to add up any ſum of pounds, ſhillings, pence, &c. 'twill be neceſſary and much to his or her advantage, to get by heart the following forms of *acquittances*, *promiſſory notes* &c. and to tranſcribe them into his or her accompt book, in order to prepare themſelves for real buſineſs. As to forms of bills of parcels &c. they will be found inſerted after the rule of *practice*.

Acquittances upon Receipt of Money.

Auguſt 4th, 1772.

Received of Mr. *Anthony Champion* the ſum of ten pounds fourteen ſhillings and nine pence in full of all demands

per *Timothy Sly*.

£10 14 9

Received 12th, *Auguſt* 1772 of Mr. *Iſaac Pedley* forty pounds on account.

per *Matthew Prior*.

£40

	£.	s.	d.
Reced *May* 2d, 1772 of Mr. *Patrick Mc Quinſey*, eighteen pounds and eighteen ſhillings, being his year's rent for 1771, for late *Bentley's* houſe &c. due *Lady Day* laſt (1772)	18	18	0

To me *William Peers*.

	£.	s.	d.
Reced 10th, *April* 1772 of Mr. *Silas Hopley*, fifteen pounds and fifteen ſhillings on account of goods ſold him	15	15	0

By me *Andrew Marvell*.

Ralph

Ralph Stanley Esq. To *James Jones* Esq. Dr.

To taxes paid for the Woodland Tenement in B—for the year 1771, as under

	£. s. d.	£. s. d.
Land tax at 4s. per pound		2 15 0
1st poors ley	0 13 9	
2d. do.	0 10 3 $\frac{3}{4}$	1 10 11 $\frac{3}{4}$
3d. do	0 6 10 $\frac{1}{2}$	
Highway do. (not any)		
Constables do.		0 6 10 $\frac{1}{2}$
Church do.		0 3 5 $\frac{1}{4}$
		£.4 16 3

Reced *April* 14th, 1772 of *Ralph Stanley* Esq. (by the hands and payment of his agent Mr. *Peter Proud*) the contents of this bill for the use of *James Jones* Esq. by me *John Toxley*.

Reced *April* 14th, 1772 of Captain *James Jones* (by the hands and payment of his agent Mr. *John Toxley*) In cash - - - - £22 13 9 per bill of taxes paid for the year 1771* £.4 16 3 in the whole twenty seven pounds and ten shillings, being his last half year's rent for 1771, for the Woodland Tenement in B— due *Lady Day* last (1772) to *Ralph Stanley* Esq. for whose use the same is received — £. s. d. 27 10 0

by me *Peter Proud*.

Reced 19th, *April* 1772 of Mr. *Ralph Jameson* (per son *George*) forty pounds being his first half year's rent for 1768, for late *Jackson's* tenement due to *Ralph Stanley* Esq at *Michaelmas* 1768, — £. s. d. 40 0 0

per *Peter Proud*.

* See the bill of taxes above.

Reced.

Reced. *April* 20th, 1772 of Mr. *Simon Tradewell*, nineteen pounds and ten ſhillings, in full for my maſter *Peter Dealer*,

By me *Robert Jacobs*.

£19 10 0

Rece'd *April* 24th, 1772 of the Right Reverend *Abiathar* Lord Biſhop of C—— by the hands of Mr. *Francis Harding*, the ſum of one hundred and fifty pounds, in full for three quarterly payments of my annuity, due *Lady Day* laſt paſt (1772)

£.150 To me *Jamima Lovely*.

February 16th, 1772 reckoned and balanced all accompts, and I *Simon Rowley* do acknowledge my ſelf to be indebted to *Beardmore Duckenfield*, five pounds four ſhillings, which I promiſe to pay to him or his order on demand, for value received as witneſs my hand,

Witneſs *Simon Rowley*.
Jacob Manlove.

Sir £5 4 0 *Whitchurch February* 18th, 1772

Pleaſe to pay to Mr. *Beardmore Duckenfield* or order, five pounds four ſhillings and place it to the account of

Your humble Servant
Simon Rowley.

To Mr. *Aaron Hill* Grocer at the three Sugar Loaves *Fleet-ſtreet London*.

London June 6th, 1772

I promiſe to pay the Honourable *Congreve Ellis* Eſq. or bearer, on demand, ſixty pounds.

For Sir *James Rich* and partners.
Thomas Trueman

£60

I promiſe

I promise to pay to Mr. *Luke Spiggot* or bearer on demand, forty pounds, *January* 19th, 1772.

per *James Jones*.

£40

I promise to pay to *Robert Heath* Esq. or order on demand, sixty-three pounds and ten shillings, value received this 24th-day *March* 1772.

by me *Thomas Holland*.

£63 10

I promise to pay to Sir *Solomon Lowe* or order, the sum of forty pounds in manner following, that is to say, twenty pounds, part thereof two months after date, ten pounds another part thereof, on the 16th, day of *December* next, and the remaining ten pounds on the 30th of *March* next (1773,) for value of him received as witness my hand at *Chester* the 15th day of *June* 1772. *Nathaniel Fisher*.

£40

Signed in the presence of
Simon Testis
Reuben Jones

SUBTRACTION.

SUBTRACTION is a useful art,
Whene'er you pay a sum in part
To find the diff'rence left behind,
As by the rule below subjoin'd.

Of

Of Simple SUBTRACTION.

RULE.

From ev'ry greater ſum ſubtract
The leſſer and to be exact,
Begin to work with units row,
And write the diff'rence down below;
And when the upper figure's leſs
Than what that under ſhall expreſs,
Add ten,—ſubtract,—and carry one
To the next figure—thus go on.

To prove ſubtraction is no more than adding the difference to the next line above it, and if the ſum be the ſame as the top-line, then the operation is right.

EXAMPLE 1.		EXAMPLE 2.	
From	94165	From	861416
Take	35641	Take	596789
Rem.	58524	Rem.	264627
Proof	94165	Proof	861416

EXAMPLE 3.		EXAMPLE 4.	
From	431678	From	900000
Take	390169	Take	345678
Rem.	41509	Rem.	554322
Proof	431678	Proof	900000

To

To work example 1st, say 1 from 5 and there remains 4, write down the difference 4 in the place of units, and say, 4 from 6 and there remains 2, which write down in the place of tens. Then say 6 from 1 I cannot, but 10 that I borrow to 1 is 11, 6 from 11 and there remains 5, then 1 that I borrowed and 5 is 6, 6 from 4 I cannot, but 6 from 14 and there remains 8, 1 that I borrowed and 3 is 4, 4 from 9 and there remains 5. Then to prove if the work be right, say 4 and 1 is 5, 2 and 4 is 6, 5 and 6 is 11, set down 1 and carry 1 to 8 is 9, and 5 is 14, set down 4 and carry 1 and say 1 and 5 is 6, and 3 is 9, which set down, and you will see that this line corresponds with the uppermost, and proves the work to be right.

EXAMPLE 2.

To work this example you must say, 9 from 6 I cannot, but 9 from 16, and there remains 7, 1 that I borrowed to 8 is 9, 9 from 1 I cannot, but 9 from 11 and there remains 2, 1 that I borrow'd, to 7 is 8, 8 from 4 I cannot, but 8 from 14 and there remains 6, 1 that I borrow'd, to 6 is 7, 7 from 1 I cannot, but 7 from 11 and there remains 4, 1 that I borrow'd to 9 is 10, 10 from 6 I cannot, but 10 from 16 and there remains 6, 1 that I borrow'd to 5 is 6, 6 from 8 and there remains 2, which set down and the work is done, but as these things are so easy, I think that any further explanation of the rest wou'd be look'd upon as prolixity only.

SCHOLIUM.

Subtraction is just the reverse of *Addition*, for instead of adding a given number, to a given number; we take a lesser given number from a greater. Many authors call the greater number the *Subtrahend*, and the lesser the *Minuend*, and the one taken from the other is the *difference*.

EXAM-

EXAMPLE 5.

Roger Bacon a learned *English Monk*, of the Franciscan order, was born near *Ilchester* in *Somersetshire*, in the year 1214. How many years is that since?

From	1772
Take	1214
Answer	558 years.

EXAMPLE 6.

The age of a lady is twenty and three,
What year was she born in, pray tell unto me?

From	1772
Take	23
Answer	1749

EXAMPLE 7.

Rene des Cartes a most eminent *French* philosopher and mathematician was born in 1596, and died in 1650. How old was he at the time of his death?

From	1650
Take	1596
Answer	54 years.

EXAMPLE 8.

Solon died 549 years before CHRIST was born, How many years was that after the creation of the world?

First, 549 + 1772 = 2321 the number of years since he died,

Then from 5779 } the number of { the creation.
Take 2321 } years since { *Solon* died.

Answer 3458

EXAMPLE 9.

Ovid a celebrated poet, and Roman knight, was born in the year of the world 3964. How many years is that since?

From 5779
Take 3964

Answer 1815 years.

EXAMPLE 10.

Since *Sisyphus* reigned, it plainly appears,
Is two thousand sev'n hundred, forty nine years,
Since *Sesac* was living who *Japetus* slew,
Is two thousand seven hundred *plus* twenty two.
Since *Hesiod* flourish'd, chronology'll fix,
Two thousand six hundred and thirty *plus* six.
Since *Tiglath-pileser* succeeded king *Pul*,
Is two thousand, five hundred thirteen years full.
Since *Nabopolassar*, old *Babylon* won,
Is two thousand three hundred ninety *plus* one.
Betwixt each event the interval of time,
I'd have you make known e'er mount science you climb.

Note

Note this queſtion I propos'd in the year 1766.
—To anſwer which firſt,

From	2749	
Take	2722	
Anſw.	27	years from *Siſyphus* to *Seſac.*
2d. From	2722	
Take	2636	
Anſwer	86	years from *Seſac* to *Heſiod.*
3d. From	2636	
Take	2513	
Anſwer	123	years from *Heſiod* to *Tiglath-pileſer.*
4th. From	2513	
Take	2391	
Anſwer	122	years from *Tiglath-pileſer* to *Nabopolaſſer.*

EXAMPLE II.

The height of the *Monument* at *London* is 202 feet, which is 24 feet higher than the *Trajan's Pillar* at *Rome*, I demand the height of the pillar?

From	202	
Take	24	
Anſwer	178	feet.

EXAMPLE 12.

Two maypoles length, thirty-six yards not more,
Diff'rence in inches, fourteen tens *plus* four.
Th' diff'rence of yards, when added to their sum,
Is twice the great pole, hence an answer 'll come.

SOLUTION.

First, 144 inches are equal to 4 yards, then it is plain per question, that 36 yards (the length of the 2 poles) added to 4 (to wit, their difference in yards) = 40 which (by question) is twice the length of the greater pole, consequently 20 is the real length thereof in yards then,

From	20	the length of the greater pole.
Take	4	the difference
Rem.	16	the length of the lesser pole.

EXAMPLE 13.

An old worthless miser just before he expired made his will, wherein he directed that the sum of 4000 l. (to wit, the amount of his estate) shou'd be divided between his wife and 4 daughters in manner following, viz. to the *eldest daughter* 1000l. *minus* 100l. to the *second daughter* 1000l. *minus* 200l. to the *third daughter* 1000l. *minus* 300l. to the *fourth daughter* 1000l. *minus* 400l. and the remaining part to the widow. What had each one to their respective share?

	£.	
From	1000	
Take	100	
Anf.	900	eldest daughter's share.

From

	£.	
From	1000	
Take	200	
Rem.	800	second daughter's share.

From	1000	
Take	300	
Rem.	700	third daughter's share.

From	1000	
Take	400	
Rem.	600	youngest daughter's share.

		£.	£.
Whole Estate	- -		4000
Eldest	Daughter's Share	900	
Second		800	
Third		700	
Youngest		600	
			3000
	Remains widow's share		1000

 A nobleman

EXAMPLE 14.

A nobleman had in his park 1000 oak, 6000 ash, 4000 beech, 900 poplar, 1146 elm, and 180 fir trees. Out of which were fal'n, 424 oak, 2346 ash, 310 beech, 149 poplar, 146 elm, and 80 fir trees. How many trees were left ſtanding in the ſaid park?

N°. of Trees.		N°. of Trees fallen.	
Oak	1000	Oak	424
Aſh	6000	Aſh	2346
Beech	4000	Beech	310
Poplar	900	Poplar	149
Elm	1146	Elm	146
Fir	180	Fir	80
In all	13226	Fallen	3455

From 13226
Take 3455

Rem. 9771

EXAMPLE 15.

The old *Salopian Par* was preſented by the *Earl* of *Arundel* to *King Charles the firſt*, at the age of 152, in the year 1635, how many years is that ſince?

From 1772
Take 1635

Anſ. 137 years.

EXAM-

EXAMPLE 16.

Once when I was at *Marb'ry School*,
  My maſter JORDAN he,
Seem'd very croſs, and call'd me fool;
  Which quite diſpleaſed me.
To me a queſtion he propos'd,
  Which almoſt crack'd my brain,
To ſolve it many hours I pos'd,
  But ſpent my time in vain.
At length he aſk'd me if I'd ſped,
  And with an angry frown,
I anſwer'd *no!* he box'd my head,
  I thought he'd broke my crown.
The queſtion was no more than this,
  Which I'll to you relate,
So eaſy ſolv'd but yet alas!
  Ne'er enter'd in my pate.
The diff'rence 'twixt twice twenty five,
  Twice five and twenty ſee,
You tell me or, as I'm alive,
  You'll ne'er a ſcholar be.

This queſtion to ſome may ſeem a *paradoxical af-fair,* but 'tis no more than from twice 25 = 50 ſubtract twice five = 10 + 20 = 30.

		5
		5
Thus	25	—
	25	10
	—	20
From	50	—
Take	30	30
	—	—
Anſ.	20 the difference	
	—	

COM-

COMPOUND SUBTRACTION.

To find the difference of two numbers when one or both are compound, or applicate quantities.

RULE.

Your numbers placed as before,
Deduct, the diff'rence less from more;
But if the lower number be
Any greater than th' top you see,
Add up such figures more to this,
As next denomination is;
Then place the diff'rence down below,
And carry one to the next row.

Examples of Money.

EXAMPLE 1.

	£.	s.	d.
From	19	14	5 ½
Take	12	16	4 ¼
Rem.	6	18	1 ¼
Proof	19	14	5 ½

EXAMPLE 2.

	£.	s.	d.
From	96	15	11 ¼
Take	84	19	10 ½
Rem.	11	16	– ¾
Proof	96	15	11 ¼

EXPLANATION of EXAMPLES, 1st, and 2d.

Take example 1st, and begin at the least denomination saying, 1 from 2 and there remains 1 farthing, which place under the line thus ¼. Then subtract 4 from 5 and there remains 1 penny, which write down under its own denomination; and proceed

ceed to the shillings and say, 16 from 14 I cannot, but 16 from 20 and there remains 4, and the 14 which is above is 18, but it is more methodical to say, 16 from 14 I cannot, but 20 that I borrow to 14 is 34, 16 from 34 and there remains 18, as before. Then because you borrowed 1 pound or 20 shillings, say 1 that I borrow d and 2 is 3, 3 from 9 and there remains 6, 1 from 1 and there remains nothing, and the remainder is 6l. 18s. 1d. $\frac{1}{4}$ which add to the line above it, and the sum will correspond with the top line, which proves the work to be right, as may be seen by the operation.

To proceed to example 2d, say 2 from 1 I cannot, but 2 from 4 and there remains 2, 2 and the 1 in the line above is 3, but it is better to say, 2 from 1 I cannot, but 4 that I borrow to 1 is 5, 2 from 5 and there remains 3 *to wit* $\frac{3}{4}$. Then proceed to the pence, and say 1 that I borrowed and 10 is 11, 11 from 11 and there remains nothing. Then say 19 from 15 I cannot, but 20 that I borrow to 15 is 35, 19 from 35, and there remains 16, and lastly begin with the pounds and say, 1 that I borrowed and 4 is 5, 5 from 6 and there remains 1. 8 from 9 and there remains 1, which numbers being all set down as you proceeded in the working, make the remainder or difference to be 11l. 16s. 0d. $\frac{3}{4}$ as may be seen in the example.

Observation.

As subtraction of money (*be the sum ever so great*) is performed after the very same manner that the two preceding examples are, it is therefore quite unnecessary to give any further explanations relating thereto, as those already given are sufficient to qualify any learner therein.

From

EXAMPLE 3.

	£.	s.	d.
From	189	16	10 ¼
Take	94	17	11 ¾
Rem.	94	18	10 ½
Proof	189	16	10 ¼

EXAMPLE 4.

	£.	s.	d.
From	9000	–	–
Take	1986	16	1 ¼
Re.	7013	3	10 ¾
Proof	9000	–	–

EXAMPLE 5.

	£.	s.	d.
Borrow'd of my friend	84	16	–
Paid him in caſh and goods	79	16	9 ½
Remains unpaid	4	19	2 ½
Proof	84	16	–

EXAMPLE 6.

Suppoſe my half year's rent is 12 guineas, and that I have laid out for the land tax and other levies 3l 19s. 3d. ½ and for ſeveral repairs 2l. 9s. 4d. ½ What remains due to the landlord ?

	£. s. d.	£. s. d.
Half year's rent		12 12 0
Land tax &c.	3 19 3 ½	6 8 8
Repairs	2 9 4 ½	
Balance due to the landlord		6 3 4

EXAM-

Example 7.

A ſteward receives for his *grace the* Duke of C * * * * the ſum of 5000l. 18s. out of which he has diſburſed upon the *Duke's* account, the ſum of 904l. 10s. 9d. What remains in the ſtewards hands, to pay his maſter?

	£.	s.	d.
From	5000	18	0
Take	904	10	9
Rem.	4096	7	3
Proof	5000	18	–

Example 8.

A Lady left her *daughter* fair,
  Twelve thouſand pound in gold,
To be diſtributed with care,
  As underneath is told.
Firſt to a *niece* there muſt be paid,
  Juſt fourteen hundred pound,
And half that ſum to *parſon Wade*,
  To make his glaſs go round.
And to her maid Miſs *Nancy Hare*,
  Three hundred pounds in caſh,
Who ſwells with pride and ſuch an air!
  She apes my lady flaſh.
The *ſtew'rd* and *butler* each muſt have,
  Juſt twice two hundred more,
And to a tenant *farmer brave!*
  In ſhining pounds ſix ſcore.
The greaſy *cook*, each other *maid*,
  B'ing *three* * *in number* they,

Had

* *Cook included.*

Had twenty guineas each one paid,
  To make them fine and gay.
The coachman *Ralph* and footman *Dan*,
  Ten guineas and a crown, * * *a piece.*
Which made them toss about the can,
  In ev'ry market town.
When all these legacies were paid,
  What did remain behind,
For *Miss* that blooming peerless maid,
  Whose virtues made her kind?

	£.	s.	d.	£.	s.	d.
Sum left - -				12000	0	0
Niece -	1400	-	-			
Parson -	700	-	-			
Miss Nancy Hare	300	-	-			
Steward and Butler	400	-	-			
Farmer Brave	120	-	-			
Cook and the two other maids	63	-	-			
Coachman and Footman	21	10	-			
				3004	10	0
The Daughter's share				8995	10	0

A Cooper

EXAMPLE 9.

A *Cooper's* bill upon a *farmer* is 24l. 10s. 11d. $\frac{1}{2}$ out of which he has received in *cash* 10l. in *corn* 4l. 16s. 8d. in *coals* 2l. 15s. 9d. $\frac{1}{2}$ and in *cheese* and *bacon* 15s. 5d. $\frac{1}{2}$. What remains due to the *Cooper*?

		£.	s.	d.	£.	s.	d.
The Cooper's Bill.					24	10	11$\frac{1}{2}$
Paid in	Cash	10	0	0			
	Corn	4	16	8	18	7	11
	Coals	2	15	9$\frac{1}{2}$			
	Cheese &c.	-	15	5$\frac{1}{2}$			
Balance due to the Cooper					6	3	0$\frac{1}{2}$

EXAMPLE 10.

HUMPHRY has in cash and effects to the value of 8000l. but is indebted to *Ambrose* 141l. to *Joseph* 60l. 14s. 9d.$\frac{1}{4}$ to *Titus* 84l. 18s. 6d. to *Aminadab* 176l. 18s. 1d.$\frac{1}{4}$ to *Simon* 340l. to *John* 678l. 18s. 4d.$\frac{1}{2}$ to *David* 987l. 18s. 4d. to *Henry* 548l. 19s. 11d.$\frac{1}{4}$ and to *Nebuchadnezzar* 671l. 18s. 4d.$\frac{3}{4}$. What is *Humphry* worth when all his debts are paid?

				£.	s.	d.
The amount of *Humphry's* cash and effects.				8000	–	–
Debts owing by him to the following persons.	£.	s.	d.			
Ambrose	141	0	0			
Joseph	60	14	9¼			
Titus	84	18	6			
Aminadab	176	18	1¾			
Simon	340	0	0			
John	678	18	4½			
David	987	18	4			
Henry	548	19	11¼			
Nebuchadnezzar	671	18	4¾			
				3691	6	5½
Humphry's neat estate				4308	13	6½

Troy Weight.

A *Lady* bought of a *Silver Smith* a silver tankard weighing 3lb. and 13 grains, and a silver cup 1lb. 2 oz. 10 dwt. and 16 grains. How much heavier is the tankard than the cup?

	(12) lb.	(20) oz.	(24) dwt.	gr.
From	3	–	–	13
Take	1	2	10	16
Rem.	1	9	9	21
Proof.	3	–	–	13

To subtract weights and measures is done in the same manner as money, only observe to borrow and add or repay according to each denomination.

Apothe-

Apothecaries Weight.

What is the difference betwixt 28lb. 10. oz. and 2lb. 5 oz. 3 dr. 2 scr. and 13 gr.

	(12)	(8)	(3)	(20)	
	lb.	oz.	dr.	scr.	gr.
From	28	10	–	–	–
Take	2	5	3	2	13.
Remains	26	4	4	–	7
Proof	28	10	–	–	–

Averdupoize Weight.

A waggon load of coals, being weighed, waggon and all, by a *machine* was 2 tons and 4 hundred. What was the weight of the coals when the waggon weighed alone 10 c. 2 qrs. and 14lb.

		(20)	(4)	(28)
	tons.	c.	qr.	lb.
From	2	4	–	–
Take	–	10	2	14
Answer	1	13	1	14
Proof	2	4	–	–

	(16)	(16)
lb.	oz.	dr.

	lb.	oz.	dr.
Delivered silk in bales, &c.	76	12	9
Reced.	9	14	11
Difference	66	13	14
Proof	76	12	9

LONG MEASURE.

From a certain town *A* to *London* is 26 miles, 4 furlongs and 16 poles, and from *A* to a *Windmill* on the road is ~~4 miles 7 furlongs and~~ 34 poles. How far is the *Windmill* from *London*.

	mls.	fur. (8)	pls. (40)
From	26	4	16
Take	4	7	34
Rem.	21	4	22
Proof	26	4	16

CLOTH MEASURE.

A linen draper bought at *Chester Fair*, 496 yards of *Irish cloth*, out of which he has sold 289 yards 2 quarters and 3 nails. How much remains unsold.

	yds.	qr. (4)	nls. (4)
From	496	–	–
Take	289	2	3
Rem.	206	1	1
Proof.	496	–	–

LAND.

Land Measure.

A *Gentleman* has a large tract of land, containing 207 acres, which he intends to convert into a ſpacious park, out of which he would firſt encloſe 24 acres, 2 roods and 18 poles for a manſion houſe, gardens &c. What will the content of the park be?

	ac.	(4) rd.	(40) pls.
From	207	–	–
Take	24	2	18
Rem.	182	1	22
Proof	207	–	–

Wine Measure.

A *Nobleman* hath two cellars, the larger contains of ſeveral kinds of liquors 2 tons and 1 hogſhead, and the other 1 ton, 2 hogſheads, 56 gallons, and 5 pints. How much liquor is there in the one more than the other?

	ton.	(4) hhd.	(63) gal.	(8) pts.
From	2	1	–	–
Take	1	2	56	5
Rem.		2	7	3
Proof	2	1	–	–

Ale and Beer Measure.

A *Brewer* delivers in one day to his customers, 12 hogsheads and 4 gallons, in another day 15 hogsheads and 47 gallons. What is the difference?

	hhds.	(51) gal.
From	15	47
Take	12	4
Rem.	3	43
Proof	15	47

Dry Measure.

Out of 9 quarters and 1 comb, take 2 pecks.

	qrs.	(2) com.	(4) bu.	(4) pks.
From	9	1	–	–
Take	–	–	–	2
Rem.	8	–	3	2
Proof	9	1	–	–

Time.

Jacob agrees by contract to serve *Laban* 14 years for his two daughters *Leah* and *Rachel*, how long had

had he to serve when 10 years, 10 months, 10 weeks, 10 days, 10 hours, 10 minutes, and 10 seconds of that time were elapsed?

	(12) yrs.	(4) mo.	(7) we.	(24) da.	(60) ho.	(60) min.	sec.
From	14	–	–	–	–	–	–
Take	11	0	3	3	10	10	10
Answer	2	11	–	3	13	49	50
Proof	14	–	–	–	–	–	–

PROMISCUOUS QUESTIONS.

Question 1st. By Mr. *Charles Hutton*, see his Arithmetic *p.* 144.

A was born when *B* was 21 years of age. how old will *A* be when *B* is 47, and what will be the age of *B* when *A* is 60?

From	47		To	60
Take	21		Add	21
Rem.	26 the age of *A*.		Sum	81 *B*'s age.

Question 2d. By Mr. *Clare*. Recreation, 4.

When the air presses with its full weight in very fair weather, it may be demonstrated that there presses upon a human body about 33905 pounds of that fluid matter; and in foul weather when the air is most light but 30624 pounds; what difference of weight lies on such a body, in the two greatest alterations of the weather?

	lb.
From	33905
Take	30624
Rem.	3281 of averdupoize weight.

Question 3.

Question 3. From Mr. *Birk's* Arithmetic, *page* 15.

In the city of *Pekin* in *China* is a bell weighing it is ſaid 120000lb. at *Nankin* in the ſame country is another weighing 50000lb. the firſt exceeds the great bell at *Erford* in *Upper Saxony* by 94600lb. How much then is the *German* bell inferior in weight to the ſecond?

	lb.	
Firſt from	120000	
Take	94600	
Rem.	25400	weight of the *German* bell.

	lb.
Then from	50000
Take	25400
Anſwer	24600

Queſtion 4. By Mr. *Daniel Fenning*, ſee his Arithmetic, *p.* 70.

A boy had 1000 marbles, and he loſt at 3 different times at play each 175, and at another time 150. How many has he ſtill in hand?

Write down the No. loſt each time which add together	175 175 175 150	From Take	1000 675
		Rem.	325
Loſt in all	675		

MUL-

MULTIPLICATION.

Of *Simple* or *abstract* Numbers.

BY this *compendious rule* we find,
More useful arts, to please the mind;
It teaches how *addition* may
Be taught in a more curious way;
That is, how often unity,
In any number there shall be.

TABLE invented by *Pythagoras*.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

This table *must be got by heart* and is so easy that it scarce needs any explanation, for 'tis no more than looking for one of the figures or factors at the top, and the other at the left hand side and the angle of meeting is the product, as for example. Suppose you wanted to know the product of 6 multiplied by 7, to know which look for 6 on the side and 7 at the top, or otherwise look

look for 7 on the side and 6 at the top, and in either angle of meeting you will find 42 the product of 6 times 7, or 7 times 6, by which you see that it does not signify which of the figures or factors you look for at the top or side, for if you look for either one at the top and the other at the side, the angle of meeting is sure to shew you the product.

RULE.

First multiply from the right hand,
According as your figures stand,
Write down what overplus you see
Above the tens, whate'er they be,
Which tens to your next product add,
And soon the answer may be had;
As demonstration plain doth shew,
If you'll proceed as taught below.

EXAMPLE I.

Multiply	6874	Multiplicand
By	4	Multiplier
	27496	Product

EXPLANATION.

To work this example you must say, 4 times 4 *is* * 16, set down 6 and carry 1, and 4 times 7 is 28 and 1 *is* † 29, set down 9 and carry 2 (*viz.* 2 tens) then say 4 times 8 is 32 and 2 is 34, set down 4 and carry 3, and lastly 4 times 6 is 24 and 3 is 27, which set down, and the product will be 27496.

* That is, *the product of* 4 times 4 *is* 16, the words *the product of*, in multiplying being always understood.

† That is, *the sum of* 28 and 1 *is* 29, the words *the sum of* in adding being always understood.

LEMMA.

LEMMA.

If you take any multiplicand and write it down as many times as the multiplier consists of units (remembering as in addition, to place units under units, tens under tens &c.) and add them up the sum will be equal to the factors (*viz.* the multiplicand and multiplier) multiplied into each other.

Now to prove the foregoing Example, set down the multiplicand 4 times as *per Lemma*.

thus	6874
	6874
	6874
	6874
and the sum is	27496 the same as the product.

EXAMPLE 2.

Multiply	146789
By	6
Product	880734

EXPLANATION.

Here say 6 times 9 is 54, set down 4 and carry 5, 6 times 8 is 48 and 5 is 53, set down 3 and carry 5, 6 times 7 is 42 and 5 is 47, set down 7 and carry 4, then 6 times 6 is 36 and 4 is 40, set down 0 and carry 4, 6 times 4 is 24 and 4 is 28, set down 8 and carry 2, 6 times 1 is 6 and 2 is 8, which compleats the product.

EXAMPLE 3.

EXAMPLE 3.

Multiply	865434	These examples are multiplied after the same manner, as the two preceding ones.
By	8	
Product	6923472	

EXAMPLE 4.

Multiply	756789	
By	12	
Product	9081468	

EXAMPLE 5.

Multiply	543214
By	16
	3259284
	543214
Product	8691424

CASE 1.

When one of the factors consists of any number between 12 and 20, it may be multiplied in one line, as may be seen by working the last example in the following manner.

	543214	
	16	
Product	8691424	the same as above

Begin

EXPLANATION.

Begin and ſay 6 times 4 is 24, ſet down 4 and carry 2, 6 times 1 is 6 and 2 is 8 and 4 the back figure makes 12, ſet down 2 and carry 1, 6 times 2 is 12 and 1 is 13 and the back figure 1 makes 14, ſet down 4 and carry 1, 6 times 3 is 18 and 1 is 19, and the back figure 2 is 21, ſet down 1 and carry 2, 6 times 4 is 24 and 2 is 26, and the back figure 3 makes 29, ſet down 9 and carry 2, 6 times 5 is 30, and 2 is 32, and the back figure 4 is 36, ſet down 6 and carry 3 to 5 is 8, which ſet down and the product is the ſame as when you multiplied by each figure in the multiplier ſeparately.

COROLLARY.

After the ſame method you may multiply any number of figures expreſſed in the ſame manner, with *ones* before the right hand figure, by adding the back figures to the product according to their places. But this method is not ſo uſeful, and ready (in my humble opinion) as the former.

CASE 2.

When the multiplier contains more than one figure; multiply each figure thro' the line, and write down the products according to their places. Add them up and you will have the true product in one line.

EXAMPLE 6.

Multiply	564217
By	27
	3949519
	1128434
Product	15233859

G Begin

Begin and multiply the multiplicand by the first figure in the multiplier namely 7. and the product will be 3949519, then multiply the multiplicand by 2 the other figure of the multiplier, and the product will be 1128434 which set down according to their places, and add them together, and you will discover the true answer or product, as you may see by the example wrought in the preceding page.

EXAMPLE 7.

Multiply	941678
By	345
	4708390
	3766712
	2825034
Product	324878910

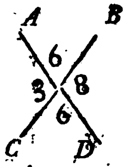
SCHOLIUM.

To prove multiplication there are two ways, one whereof (and which I think is preferable to the other) is to multiply the multiplier by the multiplicand, and if the product is the same as the other, then the work is undoubtedly right.—To prove this take the preceding example.

	345
	941678
	2760
	2415
	2070
	345
	1380
	3105
Product	324878910 the same as before

The

The other way which is moſtly taught in ſchools, but often liable to error, is very expeditious and is thus performed.



To prove the preceding example by this method, make a croſs as *A B C D*, add up all the figures of the multiplicand, and caſt away all the *nines* as you go on, thus, the firſt figure being 9, caſt that away and ſay 4 and 1 is 5 and 6 is 11, caſt away 9 and there reſts 2, then 2 and 7 is 9, and 8 remains, which place on the right hand ſide of the croſs, then caſt away the *nines* in the multiplier, thus; 3 and 4 is 7 and 5 is 12, caſt away 9 and there remains 3, which place on the left ſide of the croſs, then multiply theſe two numbers into each other, and caſt out the *nines* in the product, thus; 3 times 8 is 24, caſt away the *nines* and 6 remains which place at the top of the croſs; this being done caſt away the *nines* out of the product, thus; 3 and 2 is 5 and 4 is 9, then 8 and 7 is 15, caſt out 9 and there reſt 6, 6 and 8 is 14, caſt out 9 and there reſt 5, 5 and 1 is 6 (the 9 being rejected) which place at the bottom of the croſs, and the product is right.

EXAMPLE 8.

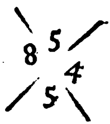
Multiply	4654301
By	6789
	41888709
	37234408
	32580107
	27925806
Product	31598049489

CASE 3.

Whenever it happens that one or both of the factors end with a cipher or ciphers, or have ciphers between the figures, you may neglect the ciphers and multiply the remaining figures (as taught before,) to this product annex the ciphers, but take care to write down or begin the first figure in the product, according to its place in the lesser factor, or multiplier. The following examples wrought out at full length will sufficiently explain the same.

EXAMPLE 9.

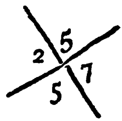
```
Multiply   1456789
By           40607
          --------
          10197523
         8740734
       5827156
       -----------
Product  59155830923
       -----------
```



Note. In the above example or any other wherein there are ciphers between the figures in the multiplier; there is no occasion (unless you are so minded) to take any notice of such ciphers, but begin the product of the next figure, directly under its place in the given factor.

EXAMPLE 10.

```
Multiply   860074000
By          50040020
        ------------
          17201480000
       344029600000
    4300370000000
    ---------------
Product 430381201614800000
    ---------------
```



Note

Note 2. In this example it is needless to put down the first quantity of ciphers to the product of each single line, for you need do no more with such ciphers, than annex the number thereof in both factors on the right hand together, when you add up the product.

C A S E 4.

When you have any factor to multiply by 10, 100, 1000 &c. annex as many ciphers thereto as there are in the multiplier, and it is done.

Multiply	1771	1771	1771
By	10	100	1000
Product	17710	177100	1771000

C A S E 5.

When large multiplications occur, and are brought into practice, as suppose it were required to multiply 2416735 by 67489, you may make a small tariff or table, thus; make a ladder of 9 or 10 steps, against the 1st, step set the multiplicand, against the 2d, its double. the 2d, step added to the first gives the 3d step, and the 3d added to the 1st, gives the 4th step, thus proceed till you have 10 steps, which last step, being ten times the multiplicand or 1st step, proves the table to be right.

1	2416735
2	4833470
3	7250205
4	9666940
5	12083675
6	14500410
7	16917145
8	19333880
9	21750615
10	24167350

Operation.

	2416735
	67489
9th step	21750615
8 ——	19333880
4 ——	9666940
7 ——	16917145
6 ——	14500410
Product	163103028415

SCHOLIUM.

I might now introduce various other methods of contracting and working *Multiplication*, by short (tho' I may truly say tedious, perplexing, and insignificant) rules, *Nepier's* Bones, &c. but these I shall omit as useless, and proceed to give the ingenious *Tyro* a few questions for practice and improvement, and then shew the extensive use of compound multiplication; so very useful in all affairs of public business trade and commerce.

Question 1.

Admit 100 men take a prize and each man's share amounts to 150l. What is the value of the prize?

	£.
	150
	100
Answer	15000

Question 2.

A *careful maid* had thirty hens,
Laid twenty eggs *per* day,
She took great care to search her pens,
Wherein her treasure lay.
The eggs she sold, the cash put by,
Still to increase her store,
Resolved was to buy a cow,
With five pounds and no more.
How many eggs, must there be sold,
To purchase *Tydy* *. say?
At five for two-pence, pray unfold
The same, for *Nancy Ray*.

* *The name of the cow.*

First

First, multiply	100	shillings = 5l.	
	By	6	the two-pences in 1s.
2d multiply		600	two-pences
	By	5	eggs
Answer		3000	eggs

Note, the number of days she will be in raising money for her cow, is easily told by division to be 150, but this must be referred to its proper place.

Question 3.

At *Hackney* a country village in *Middlesex*, it is said there are 500 houses in it; now allowing 6 persons to each house, what number of people are there in all?

$$\begin{array}{lr} & 500 \\ & 6 \\ \hline \text{Answer} & 3000 \end{array}$$

Question 4.

The water works at *London Bridge* are said to raise 1954 hogsheads in an hour, to the height of 120 feet; now suppose they work 8 hours every day, one day with another. How many hogsheads will be raised up in one year?

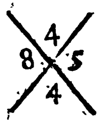
Multiply

Multiply 1954 the hhds. raiſed in an hour.
By 8

Mult. 15632 the hhds. raiſed in a day.
By 365 the days in a year

```
  78160
 93792
46896
-------
```

Anſ. 5705680 hogſheads



Queſtion 5.

Near to St. *James's*, in the park you'll find,
A fair canal delightful to mankind,
Where ſportive fiſhes gliding jump and play
When *Phœbus* warms them with refulgent ray.
The chearful warblers in ſoft accents ſing,
And harmony encores the joys of ſpring.
The crouded mall in glitt'ring luſtre ſhines,
And nature's ſcen'ry in itſelf combines.
The *duke* and *earl*, the *ſtar* and *garter'd* knight,
And *ladies* glance along in ſilver white.
Th' area of this liquid ſpace you'll find,
From what you ſee is underneath ſubjoin'd *.

To find the area of a rectangular figure (of which form the canal is) is no more than to multiply the length, by the breadth, whether it be land, water,

* Length 2800 feet, breadth 100

boards,

boards, or any other flat or superficial measure, and the product is the content or area.

Length	2800
Breadth	100
Area	280000 Feet

Question 6.

Babylon once a famous and antient city in *Egypt*, stood upon a square of 15 *miles* each way. How much ground did the whole city stand upon?

Multiply 15 } the length of a side.
By 15 }

75
15

Area 225 miles

COMPOUND MULTIPLICATION.

To multiply numbers of different denominations by any given number, observe the following

RULE.

Take care at first to multiply
Your prices by the quantity,
And when that number does exceed,
The number 12, besure take heed,
Two numbers from your table take,
Which multipli'd together make

The

The quantity—then multiply
By each, and you'll the ſum deſcry,
The worth I mean, at ſuch a price,
The method is exceeding nice.
And when your quantity's compos'd,
Of numbers odd, perhaps you're pos'd,
And ſcratch your head—but I'll ſet clear,
A method in an inſtant here.
Two numbers take, whoſe product ſee,
Comes neareſt to the quantity.
Under or o'er, it matters not,
For ſoon an anſwer may be got,
By adding if the number's leſs,
(Than what your quantity's expreſs)
As many times the price you ſee
Is wanting, then complete you'll be.
But if your product ſhou'd make more
Than what your number does require,
Then from ſuch quantity ſubtract
As many times the price exact,
And then your query ſolv'd will be,
With eaſe and perſpicuity.

SCHOLIUM.

Multiplication of applicate numbers, is a compendious and ſhort way of working the Rule of Three, by an eaſy method, without the uſe of Diviſion, and is preferable to any other method, in many caſes in buying, ſelling, and computing the value of various commodities, as cattle, corn, cheeſe, &c. &c. &c.

EXAMPLE I.

What come 3 oxen to at ten guineas *per* ox?

	£.	s.
	10	10
		3
Anſwer	31	10

When

When you are to multiply compound quantities, always begin with the loweſt denomination, and carry to the next, writing down the overplus under its own denomination, and to work this example ſay, 3 times 10 is 30 ſhillings or 1l. 10s. write down 10 and carry 1, then ſay 3 times 10 is 30 and 1 is 31 pounds, which ſet down and the anſwer is 31l. 10s. as may be ſeen in the example.

EXAMPLE 2.

What come 6lb. of ſugar to at $5\frac{1}{4}$ *per* pound?

	d.
	$5\frac{1}{4}$
	6
Anſwer	2 $7\frac{1}{2}$

Here ſay 6 times 1 is 6 farthings or 1d halfpenny, ſet down $\frac{1}{2}$ and carry 1, then 6 times 5 is 30, and 1 is 31 pence or 2s. 7d. which enter down and the product is 2s. 7d. $\frac{1}{2}$ the anſwer to the queſtion.

EXAMPLE 3.

What do 9 yards of Iriſh cloth come to at 2s. 4d. $\frac{1}{2}$ *per* yard?

	s.	*d.*
	2	$4\frac{1}{2}$
		9
Anſwer	1 1	$4\frac{1}{2}$

EXAM-

EXAMPLE 4.

What come 12 C. of cheese to at 1l. 13s. 6d. *per* hundred?

	£.	s.	d.
	1	13	6
			12
Answer	20	2	–

Note, cheese-factors and many other dealers, who buy goods by wholesale, are allowed 120lb. or 6 score to 1 c. wt. but sell them out at 112lb. *per* c. wt.

EXAMPLE 5.

What do 15 measures, or bushels of wheat come to at 6s. 9d ½ *per* bushel?

		6	9½	
			5	
	1	13	11½	price of 5 meas.
			3	
Answer	5	1	10½	

Note, when the multiplier or given quantity is greater than 12, you must consider what 2 or more numbers multiplied together or continually make the quantity given, and multiply the given rate or price by either or any of those numbers (it matters not which you use first) and that product by the second and if you make use of any more numbers proceed in like manner, and the final product will be the answer as may be seen by the preceding example and the following ones.——And if the given quantity be ever so great, you may in like manner discover the value thereof, by finding the value of the greater and lesser numbers, and adding them together as directed by the *Lemma* at the end of this rule.

EXPLA-

EXPLANATION of Example 5.

To work this Example ſay, 5 times 2 is 10 farthings or 2 pence $\frac{1}{2}$ ſet down $\frac{1}{2}$ and carry 2, then ſay 5 times 9 is 45 and 2 is 47 pence = 3s. 11d. ſet down 11 and carry 3, then 5 times 6 is 30 ſhillings and 3 is 33, = 1l. 13s. the firſt product being finiſhed, multiply that by the other number ſaying, 3 times 2 is 6 farthings or 1d. $\frac{1}{2}$, ſet down $\frac{1}{2}$ carry one and ſay, 3 times 11 is 33, and 1 is 34 pence = 2s 10d. ſet down 10, and carry 2, then 3 times 3 is 9 and 2 is 11, ſet down 1 and carry 1 and ſay. 3 times 1 is 3 and 1 is 4, 4 ten ſhillings, or 2l. then 3 times 1 is 3 and 2 is 5l. and the anſwer is 5l. 1s. 10d. $\frac{1}{2}$.

EXAMPLE 6.

A *dairy maid* deck'd with an air,
  Each market-day you'll ſee,
Who brings to *town* her *country ware*,
  Amiable and free.
Eggs, butter, bacon, cheeſe to ſell,
  Good houſewifery ſuppoſe,
Which does become the *fair one* well,
  She blooming as the roſe.
Her butter's value *Tyro* ſhew
  And each commodity,
Say what do *eighteen pounds* come to,
  At *four pence halfpenny*? *
And *ſix ſcore eggs* when *five* are ſold,
  For *two pence* and no more,
All this with eaſe you may unfold,
  And likewiſe too explore
What *thirty pounds* of cheeſe come to,
  At *three pence farthing* ſay, *

* *Per* pound.

All this with eafe you'll quickly do,
  Come hafte make no delay.
Suppofe *per pound* her bacon fold,
  At *five pence farthings three*,
Take *Wilkes's* number ‡ and unfold, ‡ 45
  The value true to me.

	$d.$	
1ft,	$4\frac{1}{2}$	
	9	
S 3	$4\frac{1}{2}$	
	2	
S 6	9	value of the butter.

2d. It is evident as the eggs were fold out at 5 for two pence, 24 or its component parts muft be the multiplier for $5 \times 24 = 120$ the whole number of eggs.

Then $24 \times 2 = 48$d. $= 4$s. the value of the eggs.

	$d.$	
3d.	$3\frac{1}{4}$	
	10	
S 2	$8\frac{1}{2}$	
	3	
S 8	$1\frac{1}{2}$	value of the cheefe.

4th,

	d.
4th,	$5\frac{3}{4}$
	9
	4 $3\frac{3}{4}$
	5
£	1 1 $6\frac{3}{4}$ value of the bacon.

		s.	d.
Butter		6	9
Eggs		4	-
Cheese		8	$1\frac{1}{2}$
Bacon	1	1	$6\frac{3}{4}$
£ 2	-		$5\frac{1}{4}$

EXAMPLE 7.

What do 56 hogs come to, at 15s. 6d. *per* hog?

	s.	d.
	15	6
		8
	6 4	-
		7
Answer £	43 8	-

EXAMPLE 8.

What come 77 acres of land to, at 1l. 4s. 6d. *per* acre?

	l.	s.	d.
	1	4	6
			11
	13	9	6
			7
£	94	6	6

EXAM-

EXAMPLE 9.

What come 81 roods of sawing to, at 7s. 6d. *per* rood?

	s.	d.
	7	6
		9
	3 7	6
		9
Answer £ 30	7	6

Note Sawyers &c. allow 400 square feet, to one rood of boards.

EXAMPLE 10.

What come 96 measures of barley to, at 3s. 2d. $\frac{1}{2}$ *per* measure?

	s.	d.
	3	2 $\frac{1}{2}$
		12
1	18	6
		8
Answer £ 15	8	–

EXAMPLE

EXAMPLE 11.

What do 99 solid feet of oak timber come to, at 1s. 6d. ½ *per* foot?

	s.	d.
	1	6 ½
		11
	16	11 ½
		9
Answer £ 7	12	7 ½

EXAMPLE 12.

Old *Farmer Careful* fond of pelf,
  To *Badger Fairtongue* sold
His *wheat*, and seems to hug himself,
  And smile upon the gold.
A *hundred bushels* were agreed,
  The *badger* straight to bring,
At *nine and six-pence!* * true indeed,
  It made old *Careful* sing.
What did the whole come to declare,
  Which pleased *Clod* so well,
And made him hobble sing and stare,
  Ingenious *Tyro* tell?

* *per bushel*

	s.	d.
	9	6
		10
4	15	–
		10
Answer 47	10	–

EXAMPLE 13.

What will 144lb. of tea come to, at 4s. 6d. $\frac{1}{2}$ *per* pound?

	s.	d.
	4	6 $\frac{1}{2}$
		12
2	14	6
		12
Answer £ 32	14	–

EXAMPLE 14.

What come 19lb. of figs to, at 3d. $\frac{3}{4}$ *per* pound?

		d.		
		3 $\frac{3}{4}$		
		6		
	1	10 $\frac{1}{2}$		
		3		
Add	5	7 $\frac{1}{2}$	price of	18lb.
		3 $\frac{3}{4}$		1
Answer S	5	11 $\frac{1}{4}$	price of	19

In this example as no two numbers multiplied together make the quantity, I take the two nearest under it, which are 6 and 3 for $6 \times 3 = 18$ then 1 remains, the price of which must be added to the value of 18, and consequently the sum will be the price of 19 as above.

EXAM-

EXAMPLE 15.

What come 38 ſheep to, at 6s. 9d. *per* ſheep?

		s.	*d.*		
		6	9		
			10		
	3	7	6		
			4		
					ſheep
From	13	10	–	the price of	40
Take		13	6	the price of	2
Rem. £	12	16	6	the price of	38 Anſwer

In this example I have taken the two neareſt numbers above the given quantity, whoſe product is 40, by which I found the value of that number of ſheep to be 13l. 10s. from which I ſubtracted twice the price of one ſheep to find the price of 38, the anſwer to the queſtion.

EXAMPLE 16.

What come 52lb. of cheeſe to, at 4d. $\frac{1}{4}$ *per* pound?

		4	$\frac{1}{4}$		
		10			
	3	6	$\frac{1}{2}$		
		5			
					lb.
To	S 17	8	$\frac{1}{2}$	the price of	50
Add		8	$\frac{1}{2}$	the price of	2
Anſ.	S 18	5		the price of	52

EXAMPLE 17.

Bought 67 loads of hay at 1l. 12s 6d. *per* load, what do they come to?

	l.	*s.*	*d.*		
	1	12	6		
			11		
	17	17	6		
			6		loads
To	107	5	–	the price of	66
Add	1	12	6	the price of	1
Answ. £	108	17	6	the price of	67

EXAMPLE 18.

Admit a master tradesman has done 86 days work, at 2s. 2d. *per diem*, what is the whole of his wages?

		s.	*d.*		
		2	2		
			12		
	1	6	–		
			7		days
To	9	2	–	the price of	84
Add		4	4	the price of	2
Answ. £	9	6	4	the price of	86

EXAM-

Example 19.

What come 106 yards of linen cloth to, at 1s. 8d. *per* yard?

	£	s.	d.		yards
		1	8		
			10		
		16	8		
			10		
To	8	6	8	the price of	100
Add	-	10	-	the price of	6
Ans. £	8	16	8	the price of	106

Example 20.

What come 126 bushels of beans to, at 4s. 2d. $\frac{1}{2}$ *per* bushel?

	£	s.	d.		bushels
		4	2 $\frac{1}{2}$		
			10		
	2	2	1		
			12		
To	25	5	-	the price of	120
Add	1	5	3	the price of	6
Ans. £	26	10	3	the price of	126

Exam-

EXAMPLE 21.

What come 1 c. *viz.* 112lb. of hops to, at 1s. 2d. ½ *per* pound?

s.	d.	
1	2 ½	
	8	
9	8	
	7	
3 7	8	price of ½ c. or 56lb.
	2	
Answ. £ 6 15	4	

In this example I first find the price of ½ c. or 56lb. which multiplying by 2 (the number of half hundreds in a hundred) I find the price of the hundred to be 6l. 15s. 4d. as may be seen by the operation.

EXAMPLE 22.

What comes a ton of cheese to, at 3d. ¼ *per* pound?

First multiply 112 by 20, to discover the number of pounds in a ton.

lb.
112
20
2240

		d.	
		3 ¼	
		8	
	2	2	
		7	lb.
	15	2	the price of ½ c. or 56
		10	half hundreds in 5c.
£7	11	8	price of 5 c.
		4	
£30	6	8	the price of the ton.

This

This example requires the continual multiplication of the price of 1lb, by the four numbers 8, 7, 10, and 4, for by the two first, the price of half a hundred or 56lb. is discovered, and by the two last the price of the whole tun; ten times four being 40, the number of half hundreds contained therein.

Troy Weight.

Example.

Admit a Silversmith has 5 bars of silver, each 4lb. 8oz. 10dwt. and 4 gr. What is the weight of the whole?

lb.	oz.	dwt.	gr.
4	8	10	4
			5
23	6	10	20

Note weights, measures, &c. are multiplied after the same manner as money, only remember to carry according to each denomination that respectively pertain thereto.

Apothecaries Weight.

Example.

An Apothecary has 7 mixtures, each 3lb. 2oz. 3dr. 2scr. and 12gr. What is the weight of the whole?

	lb.	oz.	dr.	scr.	gr.
	3	2	3	2	12
					7
Answer	22	5	3	-	4

AVERDUPOIZE WEIGHT.

EXAMPLE 1.

What is the weight of 10 caſks of raiſins when each caſk weighs 4c. 2qrs. and 20lb.

	c.	qrs.	lb.
	4	2	20
			10
Anſwer	46	3	4

EXAMPLE 2.

If a perſon hath 12 bales of ſilk, each 4lb. 11oz. and 10dr. What is the whole weight?

	lb.	oz.	dr.
	4	11	10
			12
Anſwer	56	11	8

LONG MEASURE.

EXAMPLE 1.

Multiply 40mls. 2fur. and 16pls. by 27.

	mls.	fur.	pls.
	40	2	16
			9
	362	5	24
			3
Product	1088	-	32

EXAM-

Example 2.

Multiply 100 yards 1 foot and 4 inches by 35.

	yrds.	f.	in.
	100	1	4
			7
	703	-	4
			5
Product	3515	1	8

Cloth Measure.

Example.

If a shopkeeper bought 48 pieces of *Irish* cloth, each piece containing 32 yards 2 qrs. and 3 nails. What quantity did he buy?

	yrds.	qrs.	nls.
	32	2	3
			8
	261	2	-
			6
Answer	1569	-	-

Land Measure.

Example.

If a gentleman hath 64 pieces of land, each piece containing 6 acres 3 roods and 10 poles. What is the content of the whole?

	a.	r.	pls.
	6	3	10
			8
	54	2	–
			8
Anſwer	436	–	–

Wine Measure.

Example.

Multiply 8 tons 2 hhds. and 14 gall. by 98.

t.	hd.	gl.		
8	2	14		
		12		
102	2	42		
		8		
821	1	21	the product by	96
17	–	28		2
838	1	49	the product by	98

Beer

Beer Measure.

Example.

Multiply 19 hhds. 2 kil. 6 gal. 6 pts. by 103.

h.	k.	g.	pts.		
18	3	40	6		
			10		
197	2	16	4		
			10		
1979	2	12	–	the product by	100
59	1	3	2		3
2039	0	15	2		103

Dry Measure.

Multiply 6 lasts 3 qrs. 7 bu. 3 pecks, by 122.

	l.	qr.	b.	pcks.		
	6	3	7	3		
				12		
	76	7	5	–		
				10		
	767	6	2	–	product by	120
	12	7	7	2		2
Answ.	780	4	1	2		122

TIME.

Multiply 9 months, 2 weeks, 4 days, 12 hours, 4 minutes, by 130.

	mths.	wks.	dys.	ho.	min.		
	9	2	4	12	4		
					12		
	115	3	5	-	48		
					11		
From	1275	-	6	8	48	the pro-	132
Take	19	1	2	-	8	duct by	2
	1255	3	4	8	40		130

LEMMA.

When any large sum or sums occur in practice, as hundreds, thousands, &c. 1st, multiply the price by 10. and that product by 10 for the value of one hundred. Then multiply that product by the number of hundreds. And for the lower numbers multiply the price of 10 by the number of tens, which product write down under the value of hundreds; and then for the units multiply the price by their number which add to the other products and the sum will be the value of the whole. If your quantity is thousands, multiply the price of 100 by 10 for 1000, and the product by the number of thousands. And for the lower quantities proceed as above. The following example will make this sufficiently clear to be understood.

What

EXAMPLE.

What come 8462lb. of iron to, at 2d. ¾ *per* pound?

		d.		
		2 ¾	the price of 1lb.	
		10		
S	2	3 ½	the price of 10lb.	
		10		
£ 1	2	11	the price of 100lb.	
		10		
11	9	2	the price of 1000lb.	
		8	no. of thousands.	
				lb.
91	13	4	the price of	8000
4	11	8	the price of	400
	13	9	the price of	60
		5½	the price of	2
Anſ. £ 96	19	2½	the price of	8462

PROMISCUOUS QUESTIONS.

Queſtion 1.

How many feet tails wings and claws,
Have thirty thrave of Jack Daws?

Multiply	24	= one thrave
By	30	
	720	
	9	
	6480	

Queſtion 2d. From Mr. *Clare's* Youth's Introduction to Trade and Buſineſs.

What is the difference, and what the ſum, of ſix dozen dozen, and half a dozen dozen?

	12	a dozen		
	12			
	144	a dozen dozen		
	6			
From	864	ſix dozen dozen		
Take	72	half a dozen dozen		
Diff.	792	To	864	ſix dozen dozen
		Add	72	half a dozen doz.
		Sum	936	

Queſtion 3.

Question 3d. By Mr. *Clare*.

The *Silk-Mill* at *Derby* contains 26586 wheels, and 97746 movements, which wind off or throw 73726 yards of silk every time the great water wheel, which gives motion to all the rest goes about, which is three times in a minute. The question is, how many yards of silk may be thrown by this machine in a day, reckoning ten hours a day's work, and how many in the compass of a year, deducting for Sundays and Holydays 63 days, provided no part of it stands still?

	73726	
	3	
	221178	yards in 1 minute
	60	minutes in an hour
	13270680	yards in 1 hour
	10	hours to the day as *per* ques.
	132706800	yards in 1 day
	302	days in a year, exclusive of (the 63 holydays
	265413600	
	3981204000	
Answer	40077453600	yards in a year.

Question 4.

Question 4. By the celebrated Mr. *Malcolm.*

There are 7 chests of drawers, in each of which are 18 drawers, and in each of these are 6 divisions, in each of which there is 16l. 6s. 8d. How much money is in the whole?

	l.	*s.*	*d.*	
	16	6	8	
			6	divisions in each drawer
	98	-	-	pounds in each drawer
	18			drawers in each chest
	784			
	98			
	1764			pounds in each chest
	7			chests
Answer	12348			pounds in the whole

Question 5. By Mr. *Daniel Fenning.*

If I spend 1d. $\frac{3}{4}$ or 7 farthings *per* day, how much is that in a year, allowing 365 days to the year.

			d.
			1 $\frac{3}{4}$
			10
	S	1	5 $\frac{1}{2}$
			10
		14	7
			3
£	2	3	9
		8	9
			8$\frac{3}{4}$
Answer £	2	13	2$\frac{3}{4}$

DIVISION.

DIVISION.

DIVISION teacheth to explore,
How often two's in twenty-four,
Or any numbers great or small,
The product being the times in all.
Division and subtraction are,
The same when numbers we compare,
This lesson often has been took,
To be the hardest in this book,
In all arithmetical rounds,
Not fractions more with art abounds,
What I have written here to you,
George Fisher * doth aver is true.

Of Simple, *or* Abstract *Numbers.*

RULE.

How to divide and be exact,
First seek, then multiply, subtract,
Take care that your divisors stand,
On the left side your dividend.
And that your quotient always be,
Upon the right, as here you see.

* See *Fisher's* arithmetic *p.* 90.

Exam-

EXAMPLE I.

Divide 691672 by 4

dividend

Divisor 4) 691672 (172918 quotient

```
4
—
29
28
—
 11
  8
 —
  36
  36
  —
    7
    4
    —
    32
    32
    —
     0
    —
```

EXPLANATION.

To work this example set down the divisor and dividend as in the work, then ask how oft 4 in 6, once, place 1 in the quotient and multiply the divisor 4 thereby, saying once 4 is 4, which set down under 6 in

in the dividend and subtract saying, 4 from 6 and there remains * 2, to which bring down 9 the next figure in the dividend (and to avoid making mistakes in bringing down the right figure, it will be necessary to prick under each figure in the dividend as you bring them down) then ask how oft 4 in 29 answer 7, which place in the quotient and say 7 times 4 is 28 which set down under 29 and subtracting 28 from 29 there remains 1, to which bring down the next figure in the dividend namely 1, then ask how oft 4 in 11, 2 times, place 2 in the quotient and say, 2 times 4 is 8 which set down under 11, and say 8 from 11 and there remains 3, to which bring down the next figure 6, and ask how oft 4 in 36, place the answer 9 in the quotient and say, 9 times 4 is 36 which set down under 36 and subtract and there remains nothing, then bring down the next figure 7 and ask how oft 4 in 7 place 1 the answer in the quotient and say once 4 is 4 which set down under 7 and subtract saying 4 from 7 and there remains 3, then bring down 2 the last figure in the dividend and say, how oft 4 in 32, set down the answer 8 in the quotient and multiply the divisor thereby saying, 8 times 4 is 32, 32 from 32 and there remains nothing and the work is finished, whereby it appears that the *figure* or *number* 4 *is* contained in 691672 just 172918 times, to discover which was the thing required. This question is the same, as if one should ask in 691672 farthings how many pence? the answer wou'd be 172918 pence.

---

* That is, there remains *the number* 2, or *the number* 2 remains, *the number* in such cases being always understood.

EXAMPLE 2.

Example 2.

Divide 86547 by 7

```
7) 86547 (12363
   7....
   —
   16
   14
   —
    25
    21
    —
     44
     42
     —
      27
      21
      —
       6
      —
```

The above example is worked in the same manner as the former one, the quotient or times the divisor 7 is contained in the dividend is 12363 and 6 remains.

Exam-

EXAMPLE 3.

Divide 541678 by 12

```
12) 541678 (45139
    48
    --
     61
     60
     --
      16
      12
      --
       47
       36
       --
       118
       108
       ---
        10 remainder
        --
```

EXAMPLE 4.

Admit from *West Chester* to *London* I go,
Whose distance in miles I have placed below, †
If I trudge on my feet, just five days we'll allow
To compass the journey along with friend *Howe*:
What miles and odd yards must we travel each day,
Ingenious fair *Ladies* be pleas'd to display?

---

† 182 miles.

5) 182 (36 miles and 2 fifths of a mile =
   15   704 yrds. for 2 × 1760 (the yrds.
   ——   in a mile) = 3520
   32   divided by 5 = 704.
   30
   ——
    2
   ——

EXAMPLE 5.

Divide 89012 by 24

24) 89012 (3708
    72
    ——
    170
    168
    ———
     212
     192
     ———
      20 remains
      ——

EXPLANATION of *Example* 5.

Having placed the numbers as in the work, ask how oft 24 in 89, or which is better, how oft 2 in 8, and you may soon discover that 4 times will be too many, for 4 times 2 is 8, and you will have 1 to carry thereto from the other figure in your divisor, therefore place 3 in the quotient and multiply the divisor thereby, saying 3 times 4 is 12 set down 2 under the 9 and carry 1 and say, 3 times 2 is 6 and 1 is 7 which set down under the 8 and subtract, saying 2 from 9 and

and there remains 7, 7 from 8 and there remains 1, then bring down the 9 and enquire how oft 2 in 17, which will be but 7 times because you will have 2 to carry from the other figure of the divisor, therefore set down 7 in the quotient and multiply the divisor thereby, the product is 168 which place under 170, then subtract and the remainder is 2, bring down the next figure (of the dividend) 1 and see how oft the divisor 24 in 21, answer 0 times, place a cipher in the quotient and bring down 2 the last figure of the dividend, then seek how oft 24 in 212, or how oft 2 in 21, the two first figures in the new dividend, which cannot be 9 times because 9 times 24 is 216 which you cannot take from 212 so you see it will be but 8 times, then place 8 in the quotient and multiply the divisor thereby and the product will be 192. which place under 212 and subtract as before, and there remains 20, which set down and the work is finished, and the quotient is found to be 3708 and 20 remaining. This question is the same as if one should ask in 89012 halfpence, how many shillings? the answer would be 3708 shillings and 20 halfpence or ten-pence remaining.

Note. The remainder after every subtraction is always to be less than the divisor, otherwise the work is wrong and must be rectified (before you can proceed farther) by increasing the last found figure in the quotient until the remainder be less, and you must never bring down from the dividend more than one figure at a time, and for every figure you bring down, place or put a figure or cipher in the quotient.

EXAMPLE 6.

```
47) 8460 (180
    47
    ---
    376
    376
    ---
      0
    ---
```

SCHOLIUM.

There are various ways of proving division, and for the exercise of the learner I shall prove it by three different ways, first by multiplying the quote by the divisor, secondly by casting away the *nines* as in multiplication, and lastly by addition.

First Method.

Take the quotient of the last example and multiply it by the divisor.

```
thus  180
       47
     ----
     1260
     720
     ----
     8460 Same as the dividend.
     ----
```

Second Method.

Take the same example and cast away the *nines* in the divisor and quotient, which put on each side of the cross, and cast away the *nines* out of the dividend, put the remainder at top of the cross, then multiply the side

```
   0
2  ×  0
   0
```

figures

figures thereof into each other, and cast the *nines* out of the product, and if the work be right, the remainder to be wrote at the bottom of the cross, will be the same as the top, as may be seen by this example.

The third method is thus, Add the last remainder and all the products of the divisor and quotient together as they stand in the work, and the sum will be the same as the dividend, as appears in the proof of the following example.

EXAMPLE 7.

Divide 746789 by 345

```
   345) 746789 (2164
      * 690
        ----
         567
       * 345
        ----
        2228
      * 2070
        ----
         1589
       * 1380
         ----
     *    209 last remainder
        ------
Proof  746789
       ------
```

Now to prove this example add up all the lines mark'd thus * and as there is nothing but a cipher to add the 9 (in the last remainder) to, put it down, and for the same reason put down 8, then say 2 and 3 is

is 5 and 7 is 12 and 5 is 17, set down 7 and carry 1, then 1 and 1 is 2 and 4 is 6, set down 6, and say 2 and 3 is 5 and 9 is 14, set down 4 and carry 1, 1 and 6 is 7, which set down and the sum is the same as the dividend, and proves that the division was performed right.

Example 8.

Divide 123456789 by 6004.

```
6004) 123456789 (20562
      12008
      -----
        33767
        30020
        -----
         37478
         36024
         -----
          14549
          12008
          -----
           2541 remains
           ----
Quotient  20562
Divisor    6004
          -----
          82249
       12337454
       --------
Proof  123456789
       ---------
```

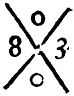
Note. In proving division by multiplying the quotient by the divisor, if there be any remainder you must add it in, as you multiply *i. e.* when you multiply by units add the units, and when by tens add the tens &c. as you may see by the proof of this example.

Example 9.

EXAMPLE 9.

Divide 987654321 by 123456

```
123456) 987654321 (8000
        987648
        -------
          6321 rem.
```



To prove this example (and all others in division that have remainders) by the cross, you must, after having cast out the *nines* in the quotient and divisor and placed the remainder on each side of the cross, cast the *nines* out of their product, and what remains over, add to the remainders at the bottom of the work casting out the *nines* and place the overplus at the top of the cross; then cast out the *nines* in the dividend, and the remainder you must place at the bottom of the cross, which will be the same as the top if the work be right, as may be seen by the proof of this example.

COROLLARY.

When you have large numbers to divide by, you may often (if not always) by inspection, tell how many times your divisor is contained in its proper period or dividual, by observing how oft the two first figures on the left hand, are contained in the two first of the dividual.

Contractions in DIVISION.

CASE 1.

When you have ciphers on the right hand of your divisor, cut of the ciphers, and also the same number of figures on the right hand of your dividend, which figures bring down to the right hand of your remainder, when the work is finished.

Divide

Divide 1772 by 20

2|0) 177|2 (88
16
—
17 88
16 20
— —
Rem. 12 1772 Proof.

Note. In this example I cut of the cipher and one figure in the dividend, and divided only by 2.

Divide 4816700 by 12000

12|000) 4816|700 (401 Quotient
48 Proof
— $401 \times 12000 + 4700 = 4816700.$
16
12
—
4700 remains

Divide 946789 by 10000

1|0000) 94|6789 (94$\frac{6789}{10000}$ Quotient.
9
— Proof
4 $94 \times 10000 + 6789 = 946789.$
4
—
6789 remains

CASE 2.

When the divisor does not exceed 12 there will be no occasion to set down the operation at large, for it may be performed by multiplying and subtracting mentally, and writing down the quotient under the dividend as may be seen in the following examples.

Divide 456789 by 8

```
8) 456789
   ------
Quote  57098——5     Proof  8 | 3
   ------                  3 | 2
```

Divide 546294 by 12

```
12) 546294
    ------
     45524——6
        12
    ------
Proof 546294
    ------
```

Explanation of *Example* 1st.

To work this example ask how oft 8 in 45, answer 5 times, set down 5 under the dividend, and say 5 times 8 is 40 from 45 and there remains 5 which makes the following figure 56, then say how oft 8 in 56, 7 times 8 is 56 from 56 and there remains nothing, then ask how oft 8 in 7 nought times, set down 0 and there remains 7, which makes the following figure 78, then say how oft 8 in 78, 9 times 8 is 72, from 78 and there remains 6 which makes the following figure 69, then seek how oft 8 in 69, 8 times 8 is 64 from 69 and there remains 5, which (as there is no more figures in the dividend) set down at the end of the quotient as a remainder and the work is compleated.

CASE 3.

CASE 3.

When it happens that the divisor is the product of two or more numbers; you may divide by those numbers or component parts, which is much easier than dividing by all the divisor at once, see the following example.

Divide 946002 by 72

```
      12) 946002
          ------
       6)  78833—6 }
          ------   } 66
Quote      13138—5 }
               6
          ------
           78833
              12
          ------
Proof     946002
          ------
```

Note. In proving by multiplication this example (and all others of the like kind) you must add or take in separately the two remainders when you multiply by their respective divisors that produced them, or which pertain thereto. And to bring these 2 remainders into *one* you must multiply the first divisor into the last remainder, and add the first remainder in, as in this example 12 times 5 is 60 and add 6 (the first remainder) thereto, the sum is 66 which will remain when the dividend in this example is divided at one operation by 72. But when there is 2 divisors and but one remainder, and that proceeds from the last divisor, then the product of the 1st divisor and that remainder will be the remainder sought. But when there is 2 divisors and one remainder and it proceeds from the 1st divisor, then that remainder is the remainder.

CASE 4.

CASE 4.

In large divisions you may make a tariff or table (as taught in multiplication) by making products of the divisor and the 9 digits, which is done by continually adding the divisor, by which tariff or table any large divisions are wrought by inspection, and to do which you are only to take out of the table the nearest less number to the dividual, and the quote figure along with it, which number must be continually subtracted from each dividual as before taught. The following example will make this clear.

Divide 41690314975 by 406502.

1	406502
2	813004
3	1219506
4	1626008
5	2032510
6	2439012
7	2845514
8	3252016
9	3658518
10	4065020

406502) 41690314975 (102558.
406502
———
1040114
813004
———
2271109
2032510
———
2385997
2032510
———
3534875
3252016
———
Remains 282859

Proof.

	4	
8		3
	4	

CASE 5.

Those who are well acquainted with the nature of division, may even in the largest divisions, subtract each figure of the product as it is produced, and write down *only* the remainders. This is commonly called the short *Italian* division, to perform which take the last example.

divide

406502) 416902149755 (102558
1040114
2271109
2385997
3534875
282859 remains as before.

SCHOLIUM.

Having now sufficiently explained *Simple Division*, I shall give two or three more questions for exercise, and then proceed to applicate numbers, or division of component parts.

Question 1.

In the *Spectators*, number nine,
Where eloquence makes learning shine,
Sir *Richard Steele*, or *Addison*
Describe a wond'rous set of men.
A club of men, exceeding queer,
As fat as bacon hogs they were;
True brawny bacchanalian souls
Who swill in large capacious bowls.
And bellies mounted to the chin,
A hogshead might be lost therein.
The *fifteen members* of this club,
Whose weight when weigh'd by Mr. *Scrub*,
Was just *three tons*, it was no more,
The weight of each then pray explore.

To answer this question is only to divide 60 (the hundreds in 3 tuns) by 15 the number of men,

thus 15) 60 (4 c. the weight of each man.
60
—
0
—

Question

Question 2.

Bethlehem Hospital, whose first benefactor was *Simon Fitzmary*, is in length 540 feet, and in breadth 40 feet. Now suppose there are 170 persons provided for at the annual expence of 1000l. How much is that apiece?

First 540 × 40 = 21600 the area.

```
17|0) 100|0 (5 £.
       85
      ---
      150
       20
     ----
17|0) 300|0 (17 s.
      17
     ---
     130
     119
     ---
      110
       12
     ----
17|0) 132|0 (7 d.
     119
     ---
     130
       4
     ---
17|0) 52|0 (3/4
      51
     ---
     10 rem.
     ---
```

Answ. 5*l.* 17*s.* 7*d.* $\frac{3}{4}$ $\frac{10}{170}$

Question 3. *For the Ladies.*

A *Governess* who well observ'd
  The morals of the *fair*,
To see her *pupils* never swerv'd
  From virtue, took great care,
Just *five and twenty Ladies* she
  Instructed, in each art,
Which does display to company,
  The most accomplish'd part.
In *Needle-work*, and *Music* few
  Could *Governess* excel,
She taught them *French* and *Dancing* too,
  Incomparably well.
Both *Reading*, *Writing and Accompts*,
  Grammatically were,
With freedom taught, each *Lady* mounts
  An elevated sphere.
To make her sex with brilliance shine,
  She took peculiar care,
When genius does with sense combine,
  To grace the lovely fair.
And to encourage sprightly youth,
  Upon a certain day,
Three hundred sugar plums in truth,
  She frankly gave away.
What number was each *Lady's* share,
  Ingenious fair ones say?
Which pleas'd no doubt the brilliant fair,
  And made them dance and play.

25) 300 (12 Answer
  25
  ——
   50
   50
   ——
   0
   ——

COM-

COMPOUND DIVISION.

To divide numbers of different denominations by a given number, observe the following

RULE.

When your divisors single are,
To work your dividend prepare;
Your highest number first divide,
Be what it will on the left side.
Let each denomination be
The same, and with your quote agree,
What rests reduce and add unto
The next inferior one you view,
Thus thro' your dividend go on,
But if your number's more than one
That you divide by, then you may
Work by their parts, an easy way,
When your divisors shall agree,
In equal products quaint and free.

LEMMA.

This useful and excellent method of division teaches how to find the price of 1 &c. in a more concise manner than the rule of Three or Reduction, for any person who has learned the four first rules in arithmetic, may easily by thought and memory bring out a final quote or answer, without a great multiplicity of figures, as will appear by the following examples. To prove compound division, multiply the quotients by the proper divisors.

Example 1.

Suppose 7 men are to pay a reckoning of 1l. 15s. 1d. $\frac{3}{4}$. What must each man pay?

		£.	s.	d.
	7)	1	15	1 $\frac{3}{4}$
Answer		-	5	- $\frac{1}{4}$
				7
Proof		1	15	1 $\frac{3}{4}$

Explanation.

To work this example ask how oft 7 in 1, never a time, then 1l. = 20s. added to 15s. is 35s. then ask how oft 7 in 35, 5 times, put down 5 in the quotient and say 35 from 35 and there remains nothing, then ask how oft 7 in 1d. never a time and there remains 1, one penny is 4 farthings and 3 is 7 how oft 7 in 7 once, set down 1 farthing and the answer is 5s. $\frac{1}{4}$.

Example 2.

A *Lady* had *nine Daughters* fair
  Of bright accomplish'd parts,
Their graces, smiles, and pleasing air,
  Attracted lovers hearts;
Young *Damon*, *Sylvius*, many more,
  Their utmost art essay'd,
To gain these fair ones and implore
  The favours of each maid.
The *Mother* was possess'd we find
  Of *eighty hundred pound*,
And being virtuous, just and kind,
  An equal share left round
To be distributed with care,
  Amongst her daughters *nine*,
Each *Lady's* fortune pray declare?
  To make your learning shine.

	£.	s.	d.
9)	8000	–	–
Answer	888	17	9 $\frac{1}{4}\frac{3}{9}$
			9
Proof	8000	–	–

First ask how oft 9 in 80, answer 8 times, repeat the operations and 8 will remain in the pounds, which reduce to shillings and proceed thro' all the denominations, and each Lady's fortune will appear to be as above. To prove which take in the remainder to the farthings.

Example 3.

If 18 cheeses (of equal weight) cost 7l. 9s. 3d. What is the price of one?

	£.	s.	d.
6)	7	9	3
3)	1	4	10 $\frac{1}{2}$
Answer	–	8	3 $\frac{1}{2}$
			3
	1	4	10 $\frac{1}{2}$
			6
Proof	7	9	3

In this example make use of two numbers viz. 6 and 3 whose product is 18.

Exam-

EXAMPLE 4. *For the Ladies.*

Says *Hodge* to his *Grandmother*, Grannum I see,
That the *money* and *purse* which you've given to me,
Is worth *sixteen and eightpence*, it's well it's no worse,
For the *cash* is in value, worth *nine times the purse*,
What sum then had *Roger* fair *Ladies* pray tell,
Which tickled his fancy and pleas'd him so well?

	s.	d.		s.	d.	
	16	8	Then	16	8	
		9	Minus	15	–	
10) 7	10	–	rem.	1	8	price of the purse.
Ans. –	15	–				

EXAMPLE 5.

If I sell 81 bushels of wheat for 30l. 7s. 6d. What is that *per* bushel?

	£.	s.	d.
9)	30	7	6
9)	3	7	6
Answer	–	7	6

EXAMPLE 6.

If I sell 100 bushels of wheat for 47l. 10s. What is the price of a bushel thereof at that rate?

	£.	s.	
10)	47	10	
10)	4	15	
Answer	–	9	6

EXAM-

Example 7.

Admit a *Farmer* sells to a *Swailer*, or *Baker*, one load of wheat, which weighed in all 2250lb averdupoize weight, now suppose (as is customary) the *Farmer* allows 75lb. to the bushel, and sells the same after the rate of 6s. 4d. *per* bushel. I demand the whole number of bushels, and price of the whole?

First divide 2250 by 75, and you have the number of bushels = 30, then multiply the price of 1 bushel by the whole number (30) and you have the price of the whole.

Operation.

1st. by division 75) 2250 (30 bushels.
225

0

		s.	d.	
2d. by multiplication		6	4	
			10	
	3	3	4	the price of 10.
			3	
£	9	10	-	the price of 30.

Note, When *Farmers* have their corn in different bags and each bag is weighed separately, they must take care to put down the weight of each bag, under each other; and add up the whole by the rules taught in simple addition.

A *quondam*

Example 8.

A *Quondam* neighbour *Farmer Giles*
Who dwells where cultivation ſmiles;
With *Seven Workmen* had agreed,
To marl a field in time of need,
For eight and ſixpence * they conſent,
And ſtraight to marl the workmen went,
They dig and fill the pregnant clay,
The loaded carts conduct away,
Till thirty acres were manur'd,
And then an *Artiſt* is procur'd
To make the pit's content be known,
As in the margin † I have ſhewn. † 2016 *yds.*
What roods, and what was each man's ſhare,
Ingenious *Tyro* pray declare?

				s.	*d.*
12)	2016			8	6
					7
6)	168		£. 2	19	6
Anſwer	28	roods.			4
			7) 11	18	– whole ſum
			Anſwer £ 1	14	– each man's ſhare.

Example 9.

At a hunting ſuppoſe *ſix ſcore Gentlemen* be,
All ſons of fair freedom and dear *Liberty*;
The banquet prepar'd with old *Boniface* dine,
To feaſt and carouſe over punch ale and wine.

* *Per* rood of 72 ſolid yards.

With

With punch bowl and ladle they fill drink and sing
And seem to adore mighty *Bacchus* the king.
For Bacchanals who favour the bottle and glass,
Will smile on full bumpers wherever they pass.
If *sixty-three pounds* do the reckoning defray,
Then what must *each Gentleman* equally pay?

	£.		
12)	63		
10)	5	5 s.	
Answ.	S	10	6 d. each.

EXAMPLE 10.

If 1 hund. weight of hops* cost 6l. 15s. 4d. What is the price of 1 pound?

	£.	s.	d.
2)	6	15	4
7)	3	7	8
8)	-	9	8
Answer	-	1	2½

* See example 21 *page* 94, this being the reverse of that and requires 3 divisions.

COROLLARY.

When the divisor can't be produced by multiplication of small numbers, you must divide as in long division.

EXAM-

EXAMPLE 11.

Divide 100l. 4s. 6d. $\frac{1}{2}$ into 52 parts.

```
      £.    s.  d.
52) 100    4   6 1/2 (1 £
     52
     --
     48
     20
     ---
52) 964 (18 s
     52
     ---
     444
     416
     ---
      28
      12
      ---
52)  342 (6 d.
     312
     ---
      30
       4
      ---
52)  122 (1/2
     104
     ---
      18
      --
```

Note, In this example each remainder is reduced to the next inferior denomination, and each sum whether shillings pence, or farthings added thereto.

Anf. £. 1 s. 18 d. 6$\frac{1}{2}$ $\frac{18}{52}$

Note,

Note. The following question I proposed many years ago, which was published in the *Palladium* for 1760, and afterwards taken into *Birks's Arithmetic*, and as it seems a pretty exercise for the learners of division, I shall therefore give it in this place before I proceed any further.

QUESTION.

A worthless *Miser* as I'm told,
Had hoarded up vast store of gold;
Large sums put out to usury,
Till aged *fourscore Years* and *three*
When death depriv'd him of his pelf,
And took him from his second self:
Of wives it happen'd he'd had *three*,
Three Sons, and Daughters *two* had he.
His third wife did survive him still,
But mark the tenor of his will:
Of rusty gold ten thousand pound,
Was in this *Miser's* coffer found;
Each Son must be paid down in store
Each Daughter's fortune three times o'er,
Each Daughter as the will was made
Must twice the widow's part be paid:
Now the old *Miser's* in his grave,
Tell me the fortune each must have.

SOLUTION.

It is evident by the nature of the question, that for the widow's share, 2 daughters had 4 shares, and 3 sons 18 shares; whence $1 + 4 + 18 = 23$, a divisor for the widow's part, now you must proceed to divide 20000 by 23 (as *per* last Example.)

Divide

		£.	s.	d.		
23) 10000		(434	15	$7\frac{3}{4}\frac{7}{23}$	=	Widow's
which sum	× by			2		part.
		869	11	$3\frac{1}{2}\frac{14}{23}$	=	each daughter's part.
multiply by				3		
		8608	13	$10\frac{3}{4}\frac{19}{23}$	=	each son's part.

Corrollary.

There being fractional parts in the above $\frac{7}{23}$ &c. you must multiply the parts, and if the products exceed the divisor, subtract the divisor 23 from the same and carry 1 to the farthings as you see above, when you say 3 times 14 is = 42 subtract 23 from 42 and there rest 19, which makes $\frac{19}{23}$ and 1 farthing to carry to make $\frac{3}{4}$ in each sons share.

Of Weights Measures, &c.

Divide 23lb. 6 oz. 10 dwt. 20 gr. by 5. *

	lb.	oz.	dwt.	gr.
5)	23	6	10	20
Answer	4	8	10	4

* See example 1. page 30. Here as division is the reverse of multiplication I shall divide a few of those examples to facilitate division, and then proceed to reduction &c.

To work the above example ask how oft 5 in 23, 4 times and there remains 3, then 3 times 12 is 36 and 6 is 42 oz. then ask how oft 5 in 42, 8 times, and there remains 2, two ounces or 40 dwt. 40 and 10 is 50, then how oft 5 in 5 once, how oft 5 in 0, nought times,

times, then ask how oft 5 in 20, 4 times which compleats the quotient. In the same manner all weights and measures (paying a due regard to their several denominations) are divided with ease and accuracy.

EXAMPLE.

Divide 22lb. 5 oz. 3 dr. - scr. 4 gr. by 7.

	lb.	oz.	dr.	scr.	gr.
7)	22	5	3	-	4
Answ.	3	2	3	2	12

see page 95.

EXAMPLE.

Divide 56 lb. 11 oz. and 8 dr. by 12. see *page* 96.

	lb.	oz.	dr.
12)	56	11	8
Answ.	4	11	10

I shall now beg leave to conclude this rule as the learner by this time (*having had so many examples and explanations*) cannot but be able to comprehend or surmount every difficulty that can possibly occur relating to division of any kind, and to effect which was my chief motive of dwelling so long therein.

PROMISCUOUS QUESTIONS.

Queſtion 1. By Mr. *Charles Hutton*.

The remainder of a diviſion is 325, the quote 467, the diviſor is 43 more than the ſum of both. What is the dividend?

Sol. By the nature of the queſtion and the rules in diviſion $325 + 467 + 43 = 835 \times 467 + 325 = 390270$. Anſwer.

Operation at length.

$$
\begin{array}{lrl}
 & 325 & \\
 & 467 & \\
\hline
 & 792 & \\
 & 43 & \\
\hline
\text{multiply} & 835 & \text{the diviſor} \\
\text{by} & 467 & \text{the quote, and take in 325 the remainder.} \\
\hline
 & 5850 & \\
 & 5012 & \\
 & 3343 & \\
\hline
\text{Anſ.} & 390270 & = \text{dividend as above.} \\
\hline
\end{array}
$$

Mr. *Hutton's* Solution being wrong printed as I imagine.

Question 2. by Mr. *Clare*.

By selling 240 Oranges at 5 for two-pence, half of which cost me two a penny, and the other half, 3 a penny I evidently lost a groat, pray how comes that about?

$$\begin{array}{r l} \text{First.} & 240 \\ & \underline{\quad 2} \\ 5) & \underline{480} \\ & \underline{d.\,96} = \text{what sold for} \end{array}$$

2d. $\frac{1}{2}$ 120 = 60 and $\frac{1}{3}$ 120 = 40 then 60 + 40 = 100 (what bought for.

$$\begin{array}{r l} \text{or thus } 2) & \underline{120}\ (60 \\ 3) & \underline{120}\ \underline{(40} \\ & \underline{\quad 100\text{d.}} \end{array} \qquad \begin{array}{l r} & \text{d.} \\ \text{From} & 100 \\ \text{Take} & \underline{96} \\ \text{Rem.} & \underline{4\text{d.}}\ \text{lost.} \end{array}$$

Question 3. by Mr. *Hill*. See his Arith. *p*. 62.

A Captain and 160 Soldiers gain a prize worth 362*l*. of which the Captain had $\frac{1}{5}$ for his share, the rest was divided equally among the Soldiers; what was each Man's part?

$$\begin{array}{r l} 5) & \underline{362\qquad} \\ & \underline{72\quad 8\text{ s.}} = \text{Captain's share.} \end{array}$$

	£.	s.	
From	362	–	the whole prize
Take	72	8	the Captain's share
	289	12	for the Soldiers

```
          289  12 for the Soldiers
           20
         ------
16|0) 579|2 (36 shillings.
      48
      ----
       99
       96
      ----
       32
       12          Answer each man's share.
      ----                 36s. 2d. 1/4 96/160
16|0) 38|4 (2 d.
      32
      ----
       64
        4
      ----
16|0) 25|6 (1/4  Mr. Hill makes it 36s. [illegible]
      16
      ----
rem.  96
```

The following Question (as Mr. *Malcolm* justly observes) requires all the four operations of Arithmetic.

Question 4.

Queſtion 4. by Mr. *Malcolm.*

A Father left among 5 Sons an eſtate, conſiſting of 500*l.* in caſh, with 5 bills, each of 48*l.* 10*s.* 6*d.* he ordered 20*l.* to be beſtowed upon his burial, and his debts to be paid amounting to 164*l.* Then his free eſtate to be divided in this manner *viz.* The eldeſt Son to have the 3d. part, and the other 4 Sons to have equal ſhares. What is the ſhare of each Son ?

Operation.

	£.	s.	d.		£.	
	48	10	6		20	Burial expences
			5	Bills	164	Debts
	242	12	6	A. of the B.	184	Total of out goings
	500	-	-	Caſh		
	742	12	6	Total		
	184	-	-	Deduct		
3)	558	12	6	Free eſtate		
ſub.	186	4	2	Eldeſt ſon's ſhare		
4)	372	8	4	Remains to be divided amongſt the other ſons		
	93	2	1	The ſhare of each of the other four ſons.		

R E D U C T I O N.

REDUCTION teacheth to convert
The names of numbers moſt expert,
But the ſame value ſtill retain,
As underneath I ſhall explain.
It is compounded as you'll find
With all the former rules combin'd.

RULE.

When your *Reduction* must *descend*,
Observe the strictures of a friend,
The given number multiply
With each denomination by,
Add to each product as you go,
The next inferior one below;
And when *Ascending* you divide
Just by the same you multiply'd,
The numbers then revers'd appear,
And prove each other very clear.

EXAMPLE I.

In 1*l.* how many shillings, six-pences, three-pences, pence, half-pence and farthings?

l.	
1	
20	
20	shillings
2	
40	six-pences
2	
80	three-pences
3	
240	pence
2	
480	halfpence
2	
960	farthings

To work this example and all others of the kind, you must multiply by each next inferior denomination from the given one, to that sought.

EXAM-

EXAMPLE 2.

How many farthings are there in 765l. ?

```
 £.
 765
  20
------
 15300 shillings
    12
------
183600 pence
     4
------
734400 farthings
------
```

```
          £.
Or thus  765
         960 farthings in 1 pound
        -----
       45900
      6885
      ------
Answer 734400 the same as above.
       ------
```

EXAMPLE 3.

In 24l. 16s. 4d. ½ how many farthings?

£.	s.	d.
24	16	4½

```
   20
  ----
  496 shillings
   12
  ----
 5956 pence
    4
 -----
23826 farthings
 -----
```

In this example multiply as before but observe to take in the 16s. 4d. ½ in their proper places *i. e.* the 16 in the product of shillings, the 4 in the pence, and the ½ viz. 2 farthings in the farthings, or multiply 24 the number of pounds by 960 the farthings in 1l. and to the product add the farthings in 16s. 4d. ½ and the sum will be the number of farthings sought, as appears by the following

Operation.

```
 £.                                        s. d.
   24                                      16 4½
  960 farthings in 1l.                     12
 ----                                      ---
 1440                                      196
 216                                         4
 -----                        £.  s.  d.   ---
 23040 }                    { 24  -   -    786
   786 } farthings in       {  0  16  4½   ---
 -----                      -----------
 23826  farthings in          24  16  4½
 -----                      -----------
```

EXAM-

EXAMPLE 4.

In 40 guineas how many shillings, pence and farthings?

40
21 s. = 1 guinea

40
80

840 shillings
12

10080 pence
4

40320 Farthings

EXAMPLE 5.

In 694l. 10s. How many crowns, shillings, groats and pence?

£. s.
694 10 (or 2 crowns)
4

2778 crowns
5

13890 shillings
3

41670 groats
4

166680 pence

Having worked these examples by *Reduction descending*, I shall next proceed to prove them by *Reduction ascending* or *Division*.

EXAM-

EXAMPLE 6.

In 960 farthings, how many halfpence, pence, three-pences, six-pences, shillings, and pounds?

2) 960

2) 480 halfpence

3) 240 pence

2) 80 three-pen.

2) 40 six-pences

2|0) 2|0 shillings

£ 1

EXAMPLE 7.

How many pounds are there in 734400 farthings?

4) 734400

12) 183600 pence

2|0) 1530|0 shill.

Answ. 765 pounds

EXAMPLE. 8.

In 23825 farthings how many pounds?

4) 23826

12) 5956 ½

2|0) 49|6 4d.

Answer £. 24 16s. 4d. ½

EXAM-

EXAMPLE 9.

In 40320 farthings how man guineas?

4) 40320

12) 10080

21) 840 (40 Anſ.
84

0

EXAMPLE 10.

In 166680 pence, how many groats, ſhillings, crowns and pounds?

4) 166680

3) 41670 groats

5) 13890 ſhillings

4) 2778 crowns

694 2 - crowns = £694 10*s.*

Note. Theſe 5 laſt operations prove all the 5 firſt examples by beginning with the loweſt denomination, and dividing by the numbers they were multiplied by.

Example. II.

Dick's Uncle being dead to his coffer he went,
To ſearch for the treaſure, it was his intent.
Unlocking the coffer he preſently found,
The ſum he had left him was two hundred pound,
Dick ſmiles on the hoard, as he's counting his chink,
And calls to *Ned Trotter* to bring him ſome drink.
Ned runs to the cellar and fetches a quart
Of humming ſtrong liquor to cheriſh his heart.
Dick drinks and carouſes reſolv'd to look big,
And roaring ſings *Roger de Calveley's Jigg*,
The ſight of his treaſure enliven'd his ſoul,
And made him cry out for a full flowing bowl,
Three fourths of the number of pounds in the cheſt,
Were good golden guineas and as to the reſt,
They were all half crown pieces, which pleaſed *Dick* (well,
What number of each, with much eaſe you may tell,
Dick fills all his pockets, reſolv'd to look ſmart,
And no longer trudge after the plough or the cart,
But wear a big wig and forget what is paſt,
O'er his pipe and his bottle he'll take his repaſt,
As long as his old Uncle's money will laſt.

Firſt for $\frac{3}{4}$ of 200*l.* Multiply that ſum by 3 and divide the product by 4; or divide 200 by 4, and multiply the quotient by 3. and we have 150 guineas. thus.

200	4) 200	then 150
3	———	21
———	50	———
4) 600	3	150
———	———	300
150 guineas	150 guineas	———
———	———	3150 ſhill.

1ſt *i. e.* $\frac{3}{4}$ of the number 200 were guineas and not pounds.

	£.	
	200	
	20	
From	4000	shillings
Take	3150	
	850	remains
	12	
3|0)	1020|0	
Answer	340	half crowns

EXAMPLE II.

Suppose 6 ingots each in value 18 guineas, were carried to the mint to be coined into five and three-pences. *Quere* the number?

	£.	s.	s.	d.	
	18	18	5	3	
		6	12		
	113	8	63		divisor = 7 × 9
	20				
	2268				
	12				
7)	27216				
9)	3888				
Answer	432				

Of Coins.

CASE 1.

To find the value of any Foreign Coins, in English Sterling. Multiply the given number by the lowest Denomination of the price or value of 1. and divide the product by such terms as shall bring out the value in pounds &c.

EXAMPLE 1.

In 486 Guilders of *Noremburgh* each 7*s.* 1*d.* how many pounds Sterling?

s. *d.*
7 1 486 guilders
12 85 pence in 1 guilder

85 2430
3888

12) 41310 pence in 486 guilders

2|0) 344|2 -6*d.*

Answer 172 2 6*d.*

EXAMPLE 2.

In 320 three pound twelves, or *John's* pieces of *Portugal*, how many pounds Sterling?

£. *s.*
3 12 320
20 72

72 640
2240

2|0) 2304|0

£ 1152 Answer.

Note. After this manner may any foreign coin be brought into *English* Sterling.

CASE

CASE 2.

When you are to reduce pounds Sterling into Foreign and English currency, reduce both the Sterling money and Foreign Coin into their lowest denomination, divide the one by the other and the quotient will be the Answer.

Example 1.

Admit a Merchant is to pay 496*l.* 12*s.* 3*d.* with Dollars of 4*s* 3*d.* each, how many must he procure for that purpose?

s.	d.		£.	s.	d.
4	3		496	12	3
12			20		
51		divisor	9932		
			12		

```
51) 119187 (2337 Answer
    102
    ---
     171
     153
     ---
      188
      153
      ---
       357
       357
       ---
         0
```

Example 2.

How many Guineas, half-Guineas and quarter-Guineas of each an equal number will pay 91*l.* 17*s.* 6*d.*?

£.	s.	d.
1	1	–
–	10	6
–	5	3
1	16	9
20		
36		
12		
441 divisor		

£.	s.	d.
91	17	6
20		
1837		
12		
441) 22050 (50 Answer		
2205		
0		

In this Example the 3 several pieces are added together and reduced to pence for a divisor, by which the pence in the given sum are divided to obtain the number sought, and it may be easily proved that 50 of each make the given sum or quantity, for Illustration see the work.

£.	s.
1	1
	10
10	10
	5
52	10

s.	d.
10	6
	10
5	5 –
	5
26	5 –

£.	s.	d.
–	5	3
		10
2	12	6
		5
13	2	6

Guineas

Guineas	52	10	–
Half Guineas	26	5	–
Quarter Guineas	13	2	6
Proof	91	17	6

CASE 3.

When Coins of one country or nation are to be reduced to those of another, divide one by the other in their lowest terms and the quotient will be the Answer.

EXAMPLE I.

How many pieces of eight of *Mexico* each 4*s*. 5*d*. are in, or worth 240 cobs each 4*s*. 7*d*.

s.	d.		s.	d.		
4	5		4	7		240
12			12			55
53	divisor		55	multiplier		1200
						1200

```
53) 13200 (249
    106
    ---
     260
     212
     ---
      480
      477
      ---
        3
```

Answ. 249 pieces and 3d. over.

EXAMPLE.

How many Moidores are equal to 99 Guineas?

```
                        99
                        21 shillings in a guinea
                        --
                        99
                       198
                      ----
shill. in a moid. 27) 2079 (77 Answer.
                      189
                      ----
                       189
                       189
                       ---
                         0
                         -
```

COROLLARY.

Having in the preceding Example, sufficiently shewn the method whereby money is changed from one denomination to another, I shall now proceed to Reduction of weights measures &c.

TROY WEIGHT.

EXAMPLE 1.

If a Silver Tankard weigh 1 lb. 8 oz. 14 dr, 21 grs. what is the content or weight thereof in grains?

```
lb. oz. dwt. gr.
  1   8   14  21
 12
 --
 20  ounces
 20
 ---
414  penny-weights
 24
----
1657
830
----
9957  grains
----
```

EXAMPLE 2.

In 9957 grains how many penny-weights, ounces, and pounds?

```
   4) 9957
      ----
   6) 2489-1 } grs.
      ----   } 21
 2|0) 41|4-5 }
      --
  12) 20 14
      --
       1  8 oz.
      ----
```

Note. The grains in this example are divided by 4 and 6 (= 24) in order to abbreviate the work, and in all such cases *i. e.* when any divisor consists of such a number that 2 small numbers multiplied

Ans. 1lb. 8 oz. 14dwt. 21grs.

EXAMPLE 3.

Suppose a Merchant buys 56 Ingots of Silver each weighing 21 oz. 12 dwt. and sends them to a Silversmith to be made into tankards, cups, salts and spoons, and of each an equal number, each tankard to weigh 19 oz. 18 dwt. each cup 14 oz. ½, each salt 11 oz. ¾, and each spoon 2 oz. 4 dwt. How many of each sort will they make?

		oz.	dwt.
The wt. of each	tank.	19	18
	cup	14	10
	salt	11	15
	spoon	2	4
		48	7
		20	
	divisor	967	

	oz.	dwt.
	21	12
	20	
	432	pen. w. in 1 In.
	56	no. of Ingots
	2592	
	2160	
967)	24192	(25
	1934	
	4852	
	4835	
	17	

Answer 25 of each sort and 17 dwt. over.

---

multiplied together will produce it, it will be much better to divide by those numbers and proceed with the remainders (if any there be) as directed in *page* 118, wherein are ample directions for that purpose.

Apo-

APOTHECARIES WEIGHT.

EXAMPLE 1.

In 12 lb. how many ounces, drams, scruples, and grains?

```
lb.
  12
  12
  --
 144 ounces
   8
----
1152 drams
   3
----
3456 scruples
  20
-----
A. 69120 grains
```

EXAMPLE 2.

How many scruples, drams, ounces and pounds, are there in 69120 grains?

```
2|0) 6912|0
     ----
  3) 3456 scruples
     ----
  8) 1152 drams
     ----
 12)  144 ounces
      ---
Ans.   12 pounds
       --
```

EXAMPLE 3.

In a medicinal composition of 25lb. 7oz. 3qrs. how many papers of powder may be made thereout each weighing 2 scr. 16 grs. allowing an ounce and half to be left in levigating and weighing, and admitting these powders were to be equally divided amongst 175 persons. How many must each one have?

	lb.	oz.	dr.
From the whole weight	25	7	6
Deduct the loss		1	4
	25	6	2

scr. grs.
2 16
20
—
56 divisor

25
12
—
306 ounces
8
—
2450 drams
3
—
7350 scruples
20
—
56) 147000 (2625 (15 A.
112
—
350
336
—
140
112
—
280
280
—
0

175) 2625 (15
175
—
875
875
—
0

Averdupoise Weight.

Example I.

In 10 tons 12 c. 2 qrs. 14 lb. 10 oz. and 14 dr. How many drams?

```
t.   c.  qr.  lb.  oz.  dr.
10   12   2   14   10   14
20
---
212 hundreds
  4
---
850 quarters
 28
---
 6804
1701
-----
23814 pounds
   16
-----
142884
23815
------
381034 ounces
    16
-------
2286208
381035
-------
Answ. 6096558 drams
```

EXAMPLE 2.

In 6096558 drams, how many drams?

2) 6096558

8) 3048279 - 0 } dr. 14

4) 381034 - 7

4) 95258 - 2 } oz. 10

4) 23814 - 2

7) 5953 - 2 } lb. 14

4) 850 - 3

2|0) 21|2 - 2qrs.

(14grs.

Answ. tons 10. 12c. 2qrs. 14lb. 10 oz.

EXAMPLE. 3.

Admit a *West-India* planter hath rented a plantation 7 years at 750*l.* *per Annum*, which produced annually during that term 75 ton weight of sugar, how many hogsheads each 7 *c.* ½ did the whole 7 years produce contain?

c.	qrs.	tons.	
7	2	75	
4		20	
30		1500	hundreds
		4	
	3|0	600|0	quarters
		200	hhds. in 1 y.
		7	no. of yrs.
Answ.		1400	hhds.

Or thus

tons.	
75	
7	no. of yrs.
525	whole pro-
20	in tuns.
10500	hundreds
4	
3|0) 4200|0	quarters
Ans. 1400	hhds. as before.

Example 4.

In 1400 hogſheads of ſugar, each hogſhead weigh-ing 7c. $\frac{1}{2}$. How many pounds and tons?

```
     c.  qrs.
     7   2
     4
    ——
    30  quarters
    28
   ———
   240
    60
   ———
   840  pounds in 1 hhd.
  1400  no. of hhds.
 ——————
 336000
 840
———————
4) 1176000 pounds in all
   ———————
7)  294000
   ———————
4)   42000
   ———————
2|0) 1050|0
   ———————
      525 tons
     ———
```

EXAMPLE 5.

Admit a grocer bought 9 hogſheads of ſugar, each 5c. 3qrs. 14lb. out of which ſuppoſe he has ſold 5c. 1qr. 16lb. ½. and orders the remainder to be made up into parcels of 26lb. each. How many will there be allowing 7lb. to be loſt in weighing them up?

	c.	qr.	lb.		c.	qrs.	lb.
To	5	1	16½		5	3	14
Add			7		4		
	5	1	23½		23 quarters		
	4				28		
	21				188		
	28				47		
	171				658 pounds		
	44				2		
	611				1316 half pounds in 1 hhd.		
	2				9 no. of hhds.		
	1223		From		11844 half pds. in the 9 hhds.		
			Take		1223 half pds. in the quan. ſold		

½ pds. in 1 p. 52) 10621 (204 parcels, and 6lb. ½ over
104
221
208
2) 13 half pounds
lb. 6½

Or thus,

	c.	qrs.	lb.
	5	3	14
no. of hhds.			9
The whole weight	52	3	14

	c.	qrs.	lb.
deduct the quan. sold	5	1	16 ½
also that lost in weigh.			7
	5	1	23½

remains	47	1	18½
	4		
	189 quarters		
	28		
	1520		
	379		
	5310 pounds		
	2		
52)	10621 (204 par.		
	104		
	221		
	208		
2)	13 half pds.		
lb.	6½		

Note, 14lb. being half a quarter of a hundred, therefore in multiplying by 9 in this last operation, say 9 half quarters make 4 quarters and a half *viz*. 4 qrs. and 14lb. (which is more easy than multiplying 14 by 9 which makes 126lb. = 4 qrs. 14lb.) set down the 14 and proceed, to do which is so very easy, that any directions relating thereto wou'd be looked upon as prolixity only.

Long Measure.

Example 1.

In 1 mile, how many poles, yards, feet, inches, and barley corns?

mile.	
1	
8	
8	furlongs
40	
320	poles
5½	
1600	
160	
1760	yards
3	
5280	feet.
12	
63360	inches
3	
190080	barley corns

Exam-

EXAMPLE 2.

How many inches, feet, yards, poles, furlongs and miles are there in 190080 barley corns?

```
                              3)  190080
                                  ------
                             12)  63360  inches
                                  -----
                              3)   5280  feet
                                   ----
                                   1760  yards
                                      2
                                   ----
half yards in 1 pole 11)           3520  half yards
                                   ----
                             4|0)  32|0  poles
                                   --
                              8)    8    furlongs
                                   --
                                    1    mile
                                   --
```

EXAMPLE 3.

The globe of our earth as fam'd *Norwood* has found,
Is twenty five thousand and twenty miles round,
A mighty long journey for *Seamen* to take,
Such as *Dampier* Lord *Anson* or Sir *Francis Drake*,
And such bold adventurers who sail on the Sea,
Who thousands of miles must go out of their way,
What yards feet and inches, and barley corns too
Will surround the circumference presently shew,

This was a fine question in old *Cocker's* days
When the youths of the village contended for bays,
By solving such queries, and answering fair,
What barley corns reach'd round th' terraqueous sphere.

```
     25020 miles
      1760 yards in 1 mile
   -------
   1501200
  175140
  25020
  --------
  44035200 yards
         3
 ---------
 132105600 feet
        12
----------
1585267200 inches
         3
----------
4755801600 barley corns
----------
```

If it were only required to know the number of barley corns, the answer may be obtained by one multiplication, *viz.* by multiplying the number of miles by the barley corns in one mile, *see the work.*

```
               25020 miles
              190080 barley corns in 1 mile
             -------
             2001600
           2251800
           25020
          ----------
Answer    4755801600 the same as before
          ----------
```

EXAM-

EXAMPLE 4.

Admit the *foremost* wheel of a Coach or other Carriage to be 3 ½ yards in circumference and the *hindmost* 5 ½ yards how many times will each turn round in 162 miles *viz.* between *London* and *Whitchurch* in *Shropshire.*

The half yards in 162 miles divided severally by the number of half yards in the circumference of each wheel quotes the number of times each will run round in that distance, as appears by the following

Operation.

The circum. of the $\left\{\begin{matrix}\text{lesser}\\ \text{greater}\end{matrix}\right\}$ wheel is $\left\{\begin{matrix}7\\ 11\end{matrix}\right\}$ half yards.

```
    162 miles
   1760 yards in 1 mile
   ----
   9720
  1134
  162
 ------
 285120 yards
      2
 ------
7) 570240 half yards in 162 miles
 ------
  81462 -6 viz. the lesser wheel will turn
 ------       round 81463 times, wanting
              half a yard.
```

Then for the greater wheel.

```
        half yrds.
    11) 570240
        ------
         51840 times the greater wheel
         -----           will turn round.
```

Cloth Measure.

Example 1.

In 7416 yards of cloth, how many quarters and nails?

yrds.
7416
4
————
29664 quarters
4
————
118656 nails
————

Example 2.

In 118656 nails, how many quarters and yards?

4) 118656
————
4) 29664 quarters
————
7416 yards
————

Example 3.

In 456¼ yards, how many ells *English*?

yrds. qr.
456 1
4
————
5) 1825
————
Anſw. 365
————

Example 4.

In 750 ells *English*, how many yards?

750
5
————
4) 3750 quarters
————
Anſ. 937½
————

EXAMPLE 5.

In 84 pieces of cloth each piece containing 30 yards how many suits of cloaths may be made thereout of 7 $\frac{1}{4}$ yards to the suit?

```
 7 ¼               84 pieces
 4                 30 yards in 1 piece
 —               ————
29               2520 yards in all
 —                  4
                ——————
          29) 10080 (347 suits
               87
              ————
               138
               116
              ————
                220
                203            (4¼ yards over.
               ————      Answ. 347 suits and
            4)  17
               ———— quarters
                 4¼
                 — yards
```

LAND

Land Measure.

Example 1.

To meaſure a neighbouring plain,
I took up my croſs ſtaff and chain.
Having found th' content of the whole,
Ninety acre two roods and a pole.
What roods and what perches were there
Be pleaſed to make to appear?

a.	r.	p.
90	2	1
4		
362 roods		
40		
14481 perches		

Example 2.

In 14481 perches how many acres?

40) 14481

4) 362 - 1

90 2r. 1p.

Anſwer 90 a. 2r. 1p.

Wine Measure.

Example 1.

tons pipe hhd. gal. pts.

Reduce 8 1 1 14 6 to pints.

```
     2
    ——
    17 pipes
     2
    ——
    35 hogsheads
    63
   ———
   109
   211
  ————
  2219 gallons
     8
 —————
 17758 pints
 —————
```

Example 2.

In 17758 pints how many tons?

```
8) 17758
   —————
 7) 2219-6
    ————
  9) 317   }
     ———   } 14
  2) 35-2  }
     ——
  2) 17-1
     ——
tons 8 1p. 1hhd. 14g. 6p.
     ——
```

Answ. 8 ton 1 pipe 1 hhd. 14 gal. 6 pts.

EXAMPLE 3.

In 160 chests each 128 flasks of 3 ½ pints each, how many hogsheads?

```
    160  chests
    128  flasks
   ----
   1280
   320
  160
  -----
  20480  flasks in all
     3½  pints in 1 flask
  ------
  61440
  10240
  -----
8) 71680 pints in all
  -----
 7) 8960 gallons
   -----
 9) 1280-0 }
   -----    } 14
    142-2  }
   -----
```

Answ. 142 hhds. 14 gal.

ALE

Ale and Beer Measure.

Example 1.

In 8 hogsheads how many pints?

```
   8
  51
 ----
 408 gallons
   8
 ----
3264 pints
```

Example 2.

Bring 3264 pints to hogsheads.

```
 8) 3264
    ----   hhds.
51)  408  (8 Answ.
     408
     ---
```

Dry Measure.

Example 1.

In 4 lasts, 3qrs. 2 bu. how many gallons?

```
last. qrs. bu.
  4    3    2
 10
 --
 43 qrs.
  8
 ---
 346 bushels
   8
 ----
2768 gallons
```

Example 2.

Bring 2768 gallons into lasts.

```
 8) 2768
    ----
 8)  346
    ----
1|0) 4|3 - 2
    ----
     4 - 3 - 2
```

Answ. 4 lasts 3 qrs. 2 bu.

TIME.

TIME.

How many days, hours, minutes and seconds, since the birth of our LORD and SAVIOUR JESUS CHRIST, supposing it 1772 years ago, and allowing 365 days to a year?

```
      1772
       365
    ------
      8860
    10632
    5316
    ------
    646780
        24
   -------
   2587120
  1293560
  --------
  15522720
        60
 ---------
 931363200
        60
-----------
55881792000
-----------
```

EXAMPLE 2.

In 55881792000 seconds, how many years?

```
6|0) 5588179200|0
     ------------
6|0) 93136320|0
     ----------
4)   1552272|0
     ---------
6)    388068|0
     --------- yrs.
365)  646780(1772
      365
      ---
      2817
      2555
      ----
       2628
       2555
       ----
        730
        730
        ---
          0
```

Promiscuous Questions.

Question 1 By Mr. *Fenning.*

A rich Nobleman has 5 villages, in every village 3 streets, in every street a dozen houses, in every house 5 rooms, in every room 2 bureaus, in every bureau 12 drawers, in every drawer 4 bags, every bag valued at 150 guineas; which he is going to exchange for 3*l.* 12*s* pieces, how many must he receive?

```
£.  s.
3   12          5
20              3
--              --
72 divisor      15 streets
-- (=8 × 9)     12
                --
                180 houf.
                5
                --
                900 rooms
                2
                --
                1800 burs.
                12
                --
                21600 draw.
                4
                --
                86400 bags
                150
                --
                12960000 guin.
                21
                --
                12960000
               25920000
            8) 272160000 shil-
               --
            9) 34020000
Answer         3780000 piec.
               --
```

Question 2. by Mr. *Vyse.*

Suppose *London* was built 1108 years before the birth of our SAVIOUR, how many days is it since to Christmas 1769 allowing *Julian* years of 365 days 6 hours?

```
        To  1108
        Add 1769
            ----
            2877
             365
            ----
           14385
          17262
          8631
         -------
         1050105
          * 719 - 6 hours
         -------
Anf.     1050824 days and
         -------  (6 hours
```

* 6 hours being quarter of a natural day or 24 hours, therefore divide the given number of years by 4, and the quotient will be days.

```
4) 2877
   ----
   719 days¼ or 6 hou.
   ---        over.
```

The RULE of THREE.

NOW to the *Golden Rule* we're come,
So Tyro haſte and learn a ſum;
View this extenſive Rule of art,
And learn proportion in each part,
This Rule, this *Golden Rule* of three,
Is excellent as you will ſee.
Three numbers given, great or ſmall,
It finds a fourth proportional,
To comprehend this uſeful art,
The following Rule learn well by heart.

A *General* RULE *for both* DIRECT, *and* INVERSE PROPORTION.

If any number great or leſs
Requires the ſame † for to expreſs;
Then in *Direct Proportion*, we
Bring out an anſwer ſpeedily;
But if a greater number ſhould
Require a leſs than what is told,
Or leſs a greater, than 'tis clear
Inverſe proportion muſt appear.
To ſtate your queſtion pray obſerve
You ne'er from truth and reaſon ſwerve;
Write down your terms, ſo as to name,
The firſt and third may be the ſame.
The ſecond and fourth exact agree;
Your numbers muſt reduced be

† That is, if *more* require *more* or *leſs* require *leſs*.

To

To what Denominations are
The loweſt, each to each compare.
Firſt in *Direct proportion* you,
Muſt multiply (two numbers true.)
The ſecond and third (of diff'rent name)
And by the firſt divide the ſame.
If your *Proportion* proves *Inverſe*
And greater ſums require a leſs.
Let the two firſt be multiply'd,
And by the third beſure divide.
And you will have an anſwer clear,
As quickly ſhall be made appear.

SCHOLIUM.

Before I ſhew how to work any Queſtions in this Rule it will be neceſſary to give the learner the following Inſtructions *i, e,* firſt obſerve that the firſt and fourth numbers are called *Extremes*, and the ſecond and third *Means*; the product of the *Extremes* is equal to the product of the *Means*. When the firſt term gives or requires the ſecond, we aſk what does the third term give or require alſo. If *more* be required it will be beſt (according to Mr. *Emerſon's* excellent method) to mark the *leſſer Extreme*; if *leſs* be required to mark the *greater Extreme* for a diviſor; then multiply the other two numbers together, and divide by this diviſor, the quotient is the anſwer, in the ſame denomination as the ſecond term. When there are remainders reduce them into lower denominations, and divide by the ſame diviſor.

EXAMPLE I.

As 4 is to 12, ſo is 18 to a certain number, or otherwiſe, as 4 is to 18, ſo is 12 to the ſame number, what is that number?

It is very evident that in this Example *more* is required, therefore mark the first extreme with an *Asterism* for a divisor, and proceed as before directed.

1st. As * 4 : 12 :: 18	2d, As 4 : 18 :: 12
12	12
4) 216	4) 216
54	54

COROLLARY.

Now it may be easily prov'd that the product of the two Extremes is equal to the product of the two means for $4 \times 54 = 12 \times 18 = 216$.

LEMMA I.

When the second term can be divided by the first, multiply that quotient into the third term and the product will be the answer.

To prove which take the last Example, 12 divided by $4 = 3$. and 3 multiplied by $18 = 54$.

EXAMPLE. 2.

As 6 is to 9, so is 12 to a certain number, what is the number?

* 6 : 9 :: 12
9
6) 108
Answer 18

LEMMA

LEMMA 2.

When the third term can be divided by the first, multiply that quotient by the second term and the product will be the answer.

For $12 \div 6 = 2$ and $2 \times 9 = 18$ as above.

EXAMPLE. 3.

As 24 is to 8, so is 36 to a certain number, *Quere* the number?

$$
\begin{array}{r l}
* \; 24 : 8 :: & 36 \\
& 8 \\
\hline
24) & 288 \,(12 \text{ Answer} \\
& 24 \\
\hline
& 48 \\
& 48 \\
\hline
& 0
\end{array}
$$

LEMMA 3.

When the first term can be divided by the second, and the third term by that quote; the last quotient will be the answer.

For $24 \div 8 = 3$. and $36 \div 3 = 12$ the answer as above.

EXAM-

EXAMPLE 4.

As 48 is to 84, ſo is 8 to a certain number, *Quere* the number?

$$*\ 48 : 84 :: 8$$

```
           84
            8
          ———
     48) 672 (14 Anſwer
         48
         ———
         192
         192
         ———
           0
         ———
```

LEMMA 4.

When the firſt term can be divided by the third, and the ſecond by that quote, the laſt quotient will be the anſwer.

For $48 \div 8 = 6$, and $84 \div 6 = 14$ the anſwer as above.

COROLLARY.

Having ſhewn ſome excellent rules for ordering *proportional numbers*, I ſhall next proceed to ſhew their extenſive uſe in trade, commerce, &c. But firſt I muſt obſerve to my ingenious reader, when any queſtion can be eaſily wrought out by *Compound Multiplication* or *Diviſion*, it will be more expeditiouſly done by thoſe rules, as may be ſeen by the following example.

If

If 1 ounce of Silver cost 5s. 4d. ½, what will 132 ounces cost at that rate?

First by the *Rule of Three*.

oz.	s. d.	oz.
* 1 :	5 4½ ::	132

```
          12
          --
          64
           4
          --
         258
         132
         ---
         516
        774
       258
      -----
  4) 34056
     -----
 12) 8514
     ----
2|0) 70|9-6
```

Ans. £35 9s. 6d.

Now take the reverse of this example which proves the work, and say If 132 ounces cost 35l. 9s. 6d. What will 1 ounce cost?

```
          £.  s. d.
 * 132 : 35  9  6 :: 1
           20
          ---
          709
           12
          ---   12)
   132)  8514  (64
          792   --
          ---        5s. 4d.½
          594
          528
          ---
           66
            4
          ---
   132)   264 (½
          264
          ---
            0
```

2d, By *Compound Multiplication*.

```
      s.  d.
      5   4 ½
           11
   ----------
   2 19   1 ½
           12
   ----------
An. 35  9  6   as before
   ----------
```

The same example wrought by *Compound Division*.

```
       £. s. d.
  11) 35  9  6
      --------
  12)  3  4  6
      --------
Answer    5 4½  the
        ------  same as
                before
```

These

These examples plainly ſhew the extenſive uſe of *Compound Multiplication* and *Diviſion*, and how much preferable in ſome caſes they are to the *Rule of Three*, by ſolving queſtions in a far more conciſe manner, and therefore it is very neceſſary for all perſons to be thoroughly acquainted with thoſe moſt uſeful rules namely *Compound Multiplication* and *Diviſion*.

Example 6.

If 6 yards of cloth coſt 30s. What will 78 yards coſt?

```
     yds.   s.     yds.
   * 6  :  30  ::  78
                   30
                  ----
           6)     2340
                  ----
          2|0)    39|0
                  --
              £ 19 10s.
```

Explanation.

It is very obvious that the demand lies upon 78 which therefore muſt be the *third number*, and as the *firſt number* muſt always be of the ſame name with the *third*, for that reaſon 6 muſt here be the *firſt number*, and then the other *number viz.* 30. (which is of the ſame name with the thing required) will remain and conſequently muſt be the *ſecond* or *middle number*, now the queſtion being thus ſtated and prepared for working, and as 78 yards will coſt more than 6 yards, it is manifeſt that 6 the *leſſer extreme* muſt be the diviſor, then by multiplying the *ſecond* and *third* numbers together, and dividing the product by the *firſt*

first number or *lesser extreme*, the quotient will be 390 shillings = 19l. 10s. whence the answer is 19l. 10s.

EXAMPLE 7.

If a *Soldier's* pay be 6d. *per* day, what is that a year?

```
day  d.   days
* 1 : 6 :: 365
             6
          ----
     12) 2190
          ----
     2|0) 18|2 6
          ----
  Answ.  £9 2s. 6d.
```

Note. As multiplying or dividing by 1, neither augments the multiplicand, nor decreaseth the dividend, therefore there is no occasion to divide by the first term in this example, it being an unite.

Note. By reasoning and a little consideration, it may be easily known how to state any question for the *demanding sum* or *quantity* must always be the *third number*, which must be of the same denomination as the *first*, whether money, weights, measures, or whatever else may occur in practice.

EXAM-

EXAMPLE 8.

Admit a *gentleman* has a 1000l. *per annum*, how much may he expend daily, and lay up at the year's end 315l. 12s. 6d.?

```
               £.    s.  d.
              1000   --  --
               315   12  6
             ---------------
  * 365 :  684   7   6 :: 1
                20
            -------
            13687
               12
            ------- 12)
  365) 164250 (450
       1460     ---
       ------ 2|0)3|7-6d.
        1825    --
        1825   £1 17s. 6d. Answer
        ------
           0
        ------
```

EXAMPLE 9.

If twelve pounds of bacon just cost me a crown,
For a flitch of sixscore† what must I pay down?

```
   lb.      s.       lb.
 * 12   :   5   ::   120        † pounds
                       5
                     ---
                12)  600
                     ---
                2|0) 5|0
                     --
                   £2 10s. 6d. Answer
```

EXAMPLE 10.

If four strike ‡ of corn, cost a guinea not more,
Pray what must I give for one hundred and four? ‡

b.	s.	b.
4 :	21 ::	104

‡ Bushels.

```
     104
      21
    ----
     104
     208
    ----
 4) 2184
    ----
2|0) 54|6
    ----
Answer £. 27 6s. 9d.
```

Note. The proof of each example is only varying the operation as before taught in *page* 177

EXAMPLE 11.

Suppose a Bankrupt owes 1000l. and has in money, goods, and recoverable debts, 500l. 16s. 9d. $\frac{3}{4}$. Now suppose these things delivered to his Creditors, what do they get *per* pound?

£.		£. s. d.		£.
1000	:	500 16 9 $\frac{3}{4}$	::	1

```
          20
        ----
       10016
          12
      ------
      120201
           4
      ------
1|000) 480|807
      ------
   4) 480 - 807 remains
      ----
  12) 120
      ----
Answer 10 shillings
```

In this example though there is a large remainder, yet the part of a pound each one is to receive, can be no more than 10 shillings.

EXAMPLE 12.

A *Drover* came riding a man of good mettle,
Amongst the *Welsh mountains* to buy up some *cattle.*
When the *Welshmen* espy him they splutter and stare,
Saying " Bless you coot measter, come buy our fine ware,
" They're sound wind and limb, and as fat as a pig,
" As plump as a Codlin, as sleek as a snig;
" By their horns you may see, they're young and all that,
" Come bargain coot measter, you see they are fat."
Now th' *Drover* agrees for a score of their cows,
Which fed in a meadow close by the hay-mows,
For seventy-five guineas, the sum was no more,
What each one was sold for be pleas'd to explore?

Cows Guineas Cow.
* 20 : 75 :: 1
21
———
75
150
———
2|0) 157|5
———
2|0) 7|8 - 15 = 9*d*. for 15
12
———
Ans. £ 3 18*s*. 9*d*.
2|0) 18|0
———
9

EXAMPLE 13.

Admit a Silversmith bought as much Silver, as cost him 146l. 14s. 8d. $\frac{1}{2}$, at 5s. 3d. $\frac{1}{2}$ *per* ounce. What quantity did he buy?

```
  s.  d.       oz.      £.   s.  d.
*  5  3 1/2  :  1  ::  146  14  8 1/2
  12                    20
  --                   ----
  63                   2934
   2                     12
 ---                  -----
 127                  35216
 ---                      2
                      -----  12)
              127)    70433  (554
                      635       ---- oz. dwt. grs.
                      ---    lb. 46 . 2  11 . 19  Answ.
                       693        ----------------
                       635
                       ---
                        583
                        508
                        ---
                         75
                         20
                       ---- dwts.
              127)     1500  (11
                       127
                       ---
                        230
                        127
                        ---
                        103
                         24
                        ---
                        412
                       206
                       ---- grs.
              127)     2472  (19
                       127
                       ----
                       1202
                       1143
                       ----
                         59
                         --
```


EXAM-

EXAMPLE 14.

Suppose a person fails in trade,
And does compound to pay
Just twelve and six-pence in the pound;
What was his debt I say?
When seven hundred all his store,
Of pounds was paid declare,
Young *Tyro*, and to *Phœbus* soar,
And meet *Apollo* there.

```
 s.  d.   £.    £.
*12  6  : 1  :: 700
 12             20
----         ------
 150          14000
                 12
             ------        £.
      15,0) 168000 (1120 Answer.
            15
            --
             18
             15
             --
              30
              30
              --
               0
```

Note. If the sum he owed *viz.* 1120*l.* had been given, and the rate he paid *per* £. to find the sum paid in all the question must be stated thus, as £1. : 12*s*. 6*d*. :: £ 1120 : £.700 = sum paid; and if the debt and sum paid were given to find the rate, it is as £.1120 : £ 700 :: £.1 : 12*s*. 6*d*. = rate required, which I leave for my learners exercise, see *page* 181.

EXAMPLE 15.

Bought 4 casks of raisins, each cask weighing 4c. 2qrs. 3lb. neat, what do they come to at 2*l*. 9*s*. 4*d*. $\frac{1}{2}$ per hundred?

```
                                      c. qrs. lb.
                                      4   2   3
                                              4
                                      ---------
   c.     £.  s.  d.                   
 * 1   :  2   9   4 1/2   ::          18  -  12
   4     20                            4
   -     --                           --
   4     49                           72
  28     12                           28
 ---    ---                          ---
 112    592                          578
 ---      4                          145
        ----                        ----
        2370                        2028
        2028                        ----
       -----
       18960
       4740
      47400
      -------      4)
112) 4806360 (42913
     448           -----
     ---    12) 10728 - 1/4
      326       ---------
      224   2|0) 89|4
      ---       ------------
      1023      £44 14s. -d. 1/4 Anfwer
      1008      ---------------
      ----
       156
       112
       ---
       440
       336
       ---
       104
       ---
```

Example 16.

Addressed to the young Ladies.

Fair *Sylvia* blooming as the rose in *June*,
  Oft met young *Damon* in the shady bow'rs,
Where warbling songsters chant a joyful tune,
  To chear the pair, and bless their happy hours.
Oft, very oft, this lovely couple went
  To pay a visit to the silent grove,
And mingle kisses sweet with true content,
  To seal the vows of constancy and love.
But oft embarrass'd were the lovely pair,
  By a most rigid Father's stern decree,
Who wou'd not suffer any suitors there,
  Sworn foe, to love alike and lenity.
Shou'd *Damon* near their ancient Castle come,
  He ne'er must have admittance to his dear,
For th' Father's answer was "she's not at home,
  "And really Sir, you have no bus'ness here."
Such rude behaviour long this couple bore,
  With much anxiety and fretful pain,
'Till they agreed at last to bear no more,
  But trip to *Scotland* o'er the chequer'd plain.
There to be link'd in *Hymen's* sacred tye,
  And crown their wishes by a speedy flight;
Favour'd by night fair *Sylvia* forth did fly,
  With *Damon* her enamour'd hearts delight.
Soon in the morn, ere *Phœbus* gilt the West,
  The Father was informed of the plot,
And to pursue the couple thought it best,
  So in an instant he, on horseback got.
Just thirty miles the lovers were before
  The Father when he first began to ride,
Two miles he gain'd of them *per* hour or more,
  But happily the marriage knot was ty'd
Before he did o'ertake the flying pair,
  The rate they went was seven, miles an hour,
How many hours wou'd th' Father be, ye fair,
  Ere he oertook them now to me explore?

By the question the Father went 9 miles *per* hour for the other's 7, but they were 30 miles before him at the start; whence 9—7 = 2 miles, which he gain'd *per* hour.

	miles		hour		miles
Then say *	2	:	1	::	30
					1
				2)	30
				Answer	15 hrs.

Now it may be easily prov'd, that 15 hours was the time the father overtook the lovers in, for 15 × 9 = 15 × 7 + 30 = 135 the miles rode by both parties.

EXAMPLE 17.

There is a lea or pasture which will feed 24 head of cattle 9 weeks, how long will it feed 36 head of cattle?

	hd.		weeks		hd.
	24	:	9	::	36 *
	9				
36)	216	(6 weeks Answer			
	216				
	0				

It is very evident that this example is in *Reciprocal* or *Inverse Proportion*, for 36 head of cattle will require *less time* to graze the pasture in than 24, therefore 36 the *greater extreme* must be the divisor.

EXAM-

Example 18.

Nine mowers agreed to mow down a mead,
In ten days their work they complete,
In how much time leſs, be pleas'd to expreſs
Wou'd fifteen men do the ſame feat.

m.	days	m.
9 :	10 ::	15 *

9

15) 90 (6 days
90

Now as 9 men (by the queſtion) requir'd 10 days to do the work in, and as 15 men can do it in 6, therefore they will do it in 4 days leſs, for 6 from 10 and there remains 4 the anſwer.

Example 19.

If 100l. in 12 months gain 5 Intereſt, what principal will gain as much in 9 months?

m.	l.	m.
12 :	100 ::	9 *

12

9) 1200

Anſwer £.133 6s. 8d.

Example 20.

A merry young ſpark, one night in the dark,
Came to me to borrow a crown;
Quoth he I will pay, in one year I ſay,
The caſh to you honeſtly down.
His words being true, I beg you will ſhew,
In *figures* as plain as you can,
How long he muſt lend, to requite me his friend,
Twelve ſhillings, and you are the man.

```
 s.     days     s.
 5  :   365  ::  12
          5
        ----
  12)  1825
       ----
  days  152 - 1 day
              24
              --
         12)  24
              --
       hours  2
         — Anſw. 152 days 2 hours
```

EXAMPLE 21.

If a board be eight inches in breadth, pray declare what length of the board will just make a foot square?

```
   in.        ft.      in.
   144   :    1   ::   8
     1
   ---
8) 144
   ---
Anſwer 18 inches
```

Example 22.

Admit a parlour be 30 yards round and $3\frac{1}{2}$ yards high, how many yards of painted paper three quarters of a yard wide, will be sufficient to hang the same?

yds.		yds.		qrs.
$3\frac{1}{2}$	:	30	::	3
4		14		
14		120		
		30		
	3)	420		

Answer 140 yards

Example 23.

If a cock in a vessel nine hours does require,
To empty the same, then it is my desire,
To know what cocks † more must be added thereto,
To empty it in twenty minutes? pray shew,

ho.		cocks		min.
9	:	1	::	20
60				
2|0) 54|0				

Now as 27 cocks will empty the vessel in 20 minutes, consequently 26 is the number of cocks required to be added to that which is given in the question.

† Of equal capacity.

Exam-

EXAMPLE 24. For the *Ladies*.

If a *Footman* from *Chester* to *London* shou'd run
In five days, eight hours long, between sun and sun;
Suppose when the days are twelve hours long again,
He goes the same journey quite over the plain;
What time will he do't in fair *Ladies* define?
And you shall wear *laurels* be *scholars of mine*.

```
       ho.   day     ho.
       8  :  5  ::  12
             8
            ---
      12)   40 (3 days
            36
            ---
             4
             8  length of the day in hours
            ---
      12)   32 (2 hours
            24
            ---
             8
            60  minutes in 1 hour
           ----
      12)  480 (40 minutes
           48
           --
            0
           --
```

Answer 3 days, 2 hours, 40 minutes.

PROMISE

PROMISCUOUS QUESTIONS.

Question 1. By Mr. *George Fisher.*

If that a rule of three foot long doth give five feet in shade,
And if a steeple ninety nine, how high in feet is't made?

f. s.		f. l.		f. s.
* 5	:	3	::	99
				3
			5)	297

Answer $59\frac{2}{5}$ feet.

Question 2. By the celebrated Mr. *John Tipper*, 1st author of the *Ladies Diary*, (being the first question in that miscellany for 1708, and the first that ever appear'd in that excellent work.)

Required the time of counting a million of money, at the rate of 100l *per minute*?

l.		m.		l.
* 100	:	1	::	1000000
				1
			1|00)	10000|00
			6|0)	1000|0
			4)	166–40 min.
			6)	41–2 hours
			days	6–5

	d.	h.	m.
Answer	6	22	40

(hours 22)

Question 3. By the ſame, being the 3d. queſtion in that *Miſcellany*.

If thirteen tons of claret wine,
Coſt nineteen *Engliſh* pounds,
How many pints of the ſame wine,
Are worth a thouſand crowns.

Firſt reduce 13 tons to pints = 26208 pints.

```
  £.    pints     £.
* 19 : 26208 :: 250 (= 1000 crowns)
         250
     -------
     1310400
     52416
     -------       pints
19)  6552000 (344842 2/19 Anſwer
     57
     --
      85
      76
      --
       92
       76
       --
       160
       152
       ---
         80
         76
         --
          40
          38
          --
           2 rem.
           --
```

R Queſtion

Queſtion 4. By the ſame, being the 4th queſtion in the ſaid *Diary*.

If thirteen marks, and fourteen groats,
Buy fifteen loads of hay,
How many pounds with ſixteen crowns,
For ninety loads will pay?

Firſt by Reduction 13 marks + 14 groats = 178 ſhill.

```
   loads    s.       loads                    s.
*  15    :  178   ::  90                      16 crowns
             90                                5
           ———— ſhill.                        ——
  15) 16020 (1068 price of 90 loads           80 = ſhill.
      15       80 ſhill. in 16 crowns         ——
      ——      ——
       102  2|0)98|8
        90      ——
       ——    £.49 8s. -d. Answer
       120
       120
       ——
         0
       ——
```

Queſtion 5. By Mr. *Richard Carr*, ſee his Arithmetic, *p.* 52.

If 136 maſons build a fort in 28 days, to preſerve the Soldiers from the Enemy, but the General would have it built in 8 days, how many Men muſt be ſet to work?

```
                d.      m.      d.
Reciprocally   28   :  136  ::  8 *
                        28
                       ————
                       1088
                       272
                       ————
                  8)   3808
                       ————
            Anſwer     476 men
                       ———
```

Queſtion

Queſtion 6. By Mr. *Hewet*, ſee his Arithmetic.

Two Ships ſet ſail at one time from the ſame port, one ſails 32 leagues *per* day north, and the other 45 leagues *per* day ſouth, in how many days will they be 1942 leagues aſunder?

leagues day leagues
* 77 : 1 :: 1942
1

leagues
Add { 32
45
—
77 diſtance in 1 day

days
77) 1942 (25 $\frac{17}{77}$
154
—
402
385
—
17
—

Queſtion 7. By Mr. *Leadbetter*, ſee his Mathematicians *Guide*.

A Fruiterer bought 2001 apples at three for a penny, and he alſo buys 2001 more at two for a penny, which he mingles together, and ſells them out at 5 for two-pence; I demand whether he gain'd or loſt by the bargain, and how much?

Firſt find what 2001 apples come to at three a penny.

ap. d. ap.
* 3 : 1 :: 2001
1
—
3) 2001
—
12) 667
—
2|0) 5|5 - 7*d.*
—
£2 15*s.* 7*d.*

Secondly find what 2001 come to at two a penny.

```
   ap.  d.     ap.
 * 2 : 1 :: 2001
              1
           ----
        2) 2001
           ----
       12) 1000½
           ----
      2|0) 8|3 - 4d.
           ----
         £.4 3s. 4d. ½
```

```
           £.  s.  d.
     Add { 4   3   4½
         { 2  15   7
          ---------
         £.6  18  11½ the sum
          ------- the ap-
                  ples cost.
```

Thirdly find what they were sold out for at 5 for 2d.

```
                          app.
                          2001
     app.      d.         2001
   * 5    :    2    ::    4002
                             2
                          ----
                       5) 8004
                          ----
                      12) 1600¾
                          ----
                      2|0 13|3 - 4d.
                          ----
                        £ 6 13s. 4d. ¾
```

	£.	s.	d.	
From	6	18	11½	the sum the apples cost
Take	6	13	4¾	for which they were sold
Remains	-	5	6¾	lost thereby

Question

Question 8. By Mr. *Clare*.

Suppose the battering Ram of *Vespasian* weighed 100000 pounds, and was moved, let us admit, with such a velocity, by strength of hands, as to pass through 20 feet in one second of time, and this was found sufficient to demolish the walls of *Jerusalem*; with what velocity must a bullet that weighs but 30 pounds be moved, in order to do the same execution?

	lb.		feet		lb.
Reciprocally	100000	:	20	::	30 *
			20		
3|0)	200000|0				
	$66666\frac{20}{30}$ Answer				

Question 9. By Mr. *Benjamin Donn*, see his Arithmetic *page* 129.

Suppose that in a room where two men *A* and *B* are sitting there is a fire, from which *A* is three feet, and *B* six feet distant, it is required to find how much hotter it is at *A*'s seat than at *B*'s?

To answer this question it must first be philosophically consider'd and learnt, that the effects or degrees of light heat and attraction, are reciprocally proportional to the squares of their distances, from the center whence they are propagated.

	feet		feet
A's distance	3	*B*'s distance	6
	3		6
The sqr. of *A*'s dist.	9	The sqr. of *B*'s dist.	36

Reciprocally	36	:	1	::	9 *
	1				
9)	36				
	4 Answer				

So that it is evident *A*'s place is 4 times as hot as *B*'s.

The Double Rule of Three,

Or Rule of Five Numbers.

COME *Tyro* haſte, as I'm alive,
You're mounted to the *Rule of Five*,
Where numbers five are truly given,
To find a ſixth be't odd or even;
Puſh forward then and you will ſee
'Tis call'd the *Double Rule of Three*
Becauſe two ſtatings there may be.

RULE.

Your ſecond term muſt always be,
(As in the *ſingle Rule of Three*)
The ſame denomination true,
As what is ſought appears to you;
Your terms of ſuppoſition write,
Each under each, the firſt in ſight,
And the demanding terms alſo,
You muſt put down the third in row.
Now reaſon as the *Rule of Three*,
And the diviſors you will ſee,
Which multiply together, and
A new diviſor there will ſtand.
Then th' other numbers multiply,
Each into each and you'll deſcry
Your dividend—ſo now you may
An anſwer find without delay.

EXAMPLE I.

If 100l. principal in 12 months gain 5l. intereſt, what will 180l. gain in 8 months?

Place the numbers as *per* rule *viz.* 5 for the middle term; and put the two terms of ſuppoſition 100l. and 12 months under each other in the firſt place, and then the terms of demand 180l. and 8 months muſt be put under each other in the third place, thus,

* 100l.———5l.———180l.
* 12 mo.——————— 8 mo.

Now find the diviſors by uſing the ſecond term in common for both lines or ſtatings, for (as in the *Single Rule of Three* ſo here) if the *third term* requires *more* mark the *leſſer extreme*, if *leſs* the *greater* for a diviſor, which diviſors multiplied together make a new diviſor, as appears by the following

Operation.

100l.———5l.———180l.
12 mo——————— 8 mo.

1200 diviſor 1440
5
12|00) 72|00
£6. Anſwer

SCHOLIUM.

In ſtating queſtions in this rule remember that each *ſuppoſition* muſt be of the ſame name or denomination with its reſpective *demanding term*, as may be ſeen in

in the preceding example, wherein the *first supposition* being pounds, the *first demanding term* is pounds also, and the *other supposition* being months, its *opposite demanding term* is of the same name likewise.

EXAMPLE 2.

If 30 bushels of malt are sufficient for a family of 6 persons 12 months, how many bushels will serve a family of 10 persons 24 months or, two years?

```
* 6 per. —— 30 bush. ——10 per.
* 12 mo. ——————————— 24 mo.
  ——                 ——
  72 divisor          40
  ——                 20
                     ———
                     240
                      30
                     ———
                72) 7200 (100 bushels
                    72       (Answer
                    ———
                     00
                     ——
```

EXAMPLE 3.

If forty hundred pound of beef,
Will serve four hundred *Tars*,
Just twenty days to fight the *French*,
Nor fearing death nor scars.
Then tell me *Tyro* if you please,
What pounds three hundred more
Must have to serve them thirty days,
All this you may explore.

* 400 Sai. ——— 4000 lb. ——— 300 Sai.
* 20 Days ——————— 30 Days

8000 divisor 9000
4000

8|000) 36000|000

Answer 4500lb.

EXAMPLE 4.

If 15 horses eat 60 bushels of oats in 20 days, how many bushels will 18 horses eat in 32 days?

* 15 ho. ——— 60 b. ——— 18 ho.
* 20 days ——————— 32 days

300 divisor 36
54

576
60

3|00) 345|60

bush.

$115\frac{60}{300} = 115\frac{1}{5}$ Answer.

EXAM-

EXAMPLE 5.

If the carriage of a ton weight, or 2240lb. from *Chester* to *London* which is 182 miles, at 1*d. per* lb. cost 9*l.* 6*s.* 8*d.* what will the carriage of 3 ton weight cost 240 miles?

```
* 2240lb.—9l. 6s. 8d.—6720lb. = 3 ton.
*  182 m.—20   ———————   240 m.
   ————    ————          ——————
   4480     186           268800
 17920       12           13440
 2240      ————          ————————
 ——————    2240          1612800
 407680 divisor             2240
 ——————                  ————————
                         64512000
                        3225600
                       3225600
                       ————————————  12)
             40768|0) 36126720000|0 (8861
                       326144          ————
                       ———————   2|0) 73|8 - 5d.
                        351232        ————
                        326144    £.36 18s. 5d. 1/2
                        ———————   ———————————————
                         250880
                         244608
                         ———————
                          62720
                          40768
                          ——————
                          219520
Answ. £.36 18s. 5d. 1/2       4
                          ——————
               40768|0) 87808|0 (1/2
                          81536
                          ——————
                           62720
                           —————
```

EXAM-

EXAMPLE 6.

If 10 men in eight days mow 56 acres of grafs, in how many days will 500 acres be mowed by 30 men?

10 m.———8 d,———30 m. *
* 56 ac.——————500 ac.

In this example it is very confpicuous that the firft line or ftating is in *Reciprocal* or *Inverfe Proportion*, *more* requiring *lefs*, for if 10 men do the work in 8 days, 30 men will do it in lefs, therefore 30 the *greater extreme* of that ftating muft be the divifor, and as in the other line or ftating *more* requires *more*, *viz*. 500 acres require more days than 56 acres do, therefore this ftating is in *Direct Proportion*, and confequently 56 the *leffer extreme* therein, muft be the divifor. *See the work.*

```
56 ac.                500 ac.
30 m.                  10 m.
----                  ----
1680 divifor          5000
----                     8
                      ----
          168|0) 4000|0 (23 days +
                 336        (Anfwer
                 ---
                  640
                  504
                  ---
                  136 remains
                  ---
```

EXAM-

EXAMPLE 7.

A *Col'nel* sets five hundred men,
  A trench to cast with speed;
Of just one thousand yards in length,
  Sev'n hours they take indeed
To do the same,—then in two hours,
  What men employ'd must be,
To cast twelve thousand yards t' encamp,
  His army tell to me.

* 1000 yds.——500 m.——12000 yds.
7 ho. ——————— 2 ho. *

1000	12000
2	500
2000 divisor	6000000
	7
2|000)	42000|000
Answer	21000 men.

EXAMPLE 8.

If when the bushel of wheat costs 4*s*. 6*d*. the penny loaf weighs 10, oz. What will the sixpenny loaf weigh when wheat is 8*s*. 6*d*. the bushel?

```
 s.  d.                    s.  d.
  4  6                      8  6
 12                        12
 --                        --
 54d. ---10, oz.------ 102d. *
* 1d. ------------------- 6d.
102 divisor                54
                           10
                           --
                          540
                            6
                          ---
               102) 3240 (31 oz.
                    306
                    ---
                    180
                    102
                    ---
                     78
                     20
                    ---
               102) 1560 (15 dwt.
                    102
                    ---
                    540
                    510      oz: dwt. grs.
                    ---  Ans. 31-15 7 6/102
                     30
                     24
                    ---
               102) 720 (7gr.
                    714
                    ---
                      6
```

SCHOLIUM.

The *Compound Rule of Three* is easily solved by the *Single Rule of Three* at several operations, by which I shall now work the 1st. example in *page* 199 which is as follows, *viz.* If 100l. principal in 12 months, gain 5l. Interest, what will 180l. gain in 8 months?

$$\text{First * } \overset{\pounds.}{100} : \overset{\pounds.}{5} :: \overset{\pounds.}{180}$$

```
                180
                  5
                ---
      100)      900 (9£.
                900
                ---
                  0
```

$$\text{Then * } \overset{\text{mo.}}{12} : \overset{\pounds.}{9} :: \overset{\text{mo.}}{8}$$

```
           9
           8
          --
     12)  72 (6£. Answer
          72
          --
           0
```

COROLLARY.

After the same manner may all the other examples be done at two statings as they stand, and now having sufficiently explained what is necessary in this rule, I shall give a few promiscuous questions for exercise, and then proceed to that *expeditious rule* called *Practice*, so compendiously contrived for the speedy casting up of any sort of goods or merchandize. PRO-

PROMISCUOUS QUESTIONS.

Question 1. By Mr. *Hill.*

If twenty *Dogs*, for thirty *groats*,
Go forty weeks to grafs,
How many *Hounds* for fixty *crowns*,
May winter in that place?

Firft from 52 (the weeks in a year) fubtract 40, remains 12, 30 groats = 2 crowns, then

c. dogs c.
* 2———20———60
40 wks.———————12 wks. *

12 60
2 40
— ——
24 divifor 2400
— 20
—— dogs
24) 48000 (2000 Anfwer
48
——
000
——

Question 2. By Mr. *Emerfon.*

If the carriage of 150 feet of wood, that weighs 3 ftone a foot, comes to 3l. for 40 miles; how much will the carriage of 54 feet of free-ftone, that weighs 8 ftone a foot, coft for 25 miles?

* 150 f.———3l.———54f.
* 3 ft. ——————— 8ft.
* 40 m. ——————— 25 m.

```
  150            54
    3             8
  ---           ---
  450           432
   40            25
-----           ---
18000 divisor  2160
-----           864
              -----
              10800
                  3
              -----
18|000) 32|400 (1£.
        18
        -----
        14400
           20
        -----
18|000) 288|000 (16s.
        18
        ---
        108
        108
        ---
Answ. £.1 16s.   0
        ---
```

Question 3. By Mr. *Hill.*

If 12 men build a wall 30 feet long, and 6 feet high, and 3 feet thick, in 15 days; in how many days will 60 men make a wall 300 feet long, 8 feet high, and 6 feet thick?

```
* 30 f. l.——15 d.——300 f. l.
*  6 f. h.——————————  8 f. h.
*  3 f. th.—————————  6 f. th.
  12 m. ————————————  60 m. *
```

30   300
6   15

180   1500
3   300

540   4500
60   8

32400 divisor   36000
6

216000
12

324|00) 25920|00 (80 days Answer
2592

0

Qeſtion 4. From *Palladium* 1760.

There are 8000 men in a garriſon beſieged, whoſe daily allowance is 24 ounces of bread for 7 weeks; but the governor finding the ſiege likely to continue a longer time, who can hold out 14 weeks at leaſt, tho' he has by this time loſt 1500 of his men; whereby he finds himſelf obliged to ſhorten that allowance of proviſions; how much bread muſt each man's daily allowance be reduced to?

Firſt 8000 — 1500 = 6500, then
7 w. ——— 24, oz. ——— 14 w. *
8000 m. ————————— 6500 m *

```
              8000          6500
                 7             14
             -----          -----
             56000          26000
                24          6500
            ------          -----
            224000          91000 divisor
           112000           -----
          -------
91|000) 1344|000 (14 oz.
         91
         --
         434
         364
         ---
          70000
             20
        -------
91|000) 1400|000 (15 dwt.
         91
         --
         490
         455                    oz. dwt.
         ---         Answ.  14  15 35000/91000.
          35000
          -----
```

PRACTICE

PRACTICE.

THIS Rule, for quick dispatch is plann'd,
Which, when you rightly understand,
With a conciseness you may reach
The objects, more complex-ones teach;
'Tis a contraction you may see,
Of our fine *Golden Rule of Three*.
By parts we can discover fair,
The value of all Tradesmen's ware;
And by less complicated rules,
Than some are taught in *British* Schools.

Tables of Aliquot Parts.

d.		£.		s.	s.	d.		£.
— $\frac{1}{4}$	is	$\frac{1}{960}$	or	$\frac{1}{48}$	—	8	is	$\frac{1}{30}$
— $\frac{1}{2}$	—	$\frac{1}{480}$	—	$\frac{1}{24}$	—	10	—	$\frac{1}{24}$
— $\frac{3}{4}$	—	$\frac{1}{320}$	—	$\frac{1}{16}$	1	—	—	$\frac{1}{20}$
1	—	$\frac{1}{240}$	—	$\frac{1}{12}$	1	3	—	$\frac{1}{16}$
1 $\frac{1}{4}$	—	$\frac{1}{192}$	—	—	1	4	—	$\frac{1}{15}$
1 $\frac{1}{2}$	—	$\frac{1}{160}$	—	$\frac{1}{8}$	1	8	—	$\frac{1}{12}$
2	—	$\frac{1}{120}$	—	$\frac{1}{6}$	2	—	—	$\frac{1}{10}$
2 $\frac{1}{2}$	—	$\frac{1}{96}$	—	—	2	6	—	$\frac{1}{8}$
3	—	$\frac{1}{80}$	—	$\frac{1}{4}$	3	4	—	$\frac{1}{6}$
3 $\frac{3}{4}$	—	$\frac{1}{64}$	—	—	4	—	—	$\frac{1}{5}$
4	—	$\frac{1}{60}$	—	$\frac{1}{3}$	5	—	—	$\frac{1}{4}$
5	—	$\frac{1}{48}$	—	—	6	8	—	$\frac{1}{3}$
6	—	$\frac{1}{40}$	—	$\frac{1}{2}$	10	—	—	$\frac{1}{2}$
7 $\frac{1}{2}$	—	$\frac{1}{32}$	—	—				

s.	d.		£.
–	9	is	$\frac{3}{80}$
–	10		$\frac{5}{120}$
1	2		$\frac{7}{120}$
1	3		$\frac{5}{80}$
1	4		$\frac{2}{30}$
1	6		$\frac{3}{40}$
1	9		$\frac{7}{80}$
1	10		$\frac{11}{120}$
2	3		$\frac{9}{80}$
2	4		$\frac{7}{60}$
2	8		$\frac{4}{30}$ or $\frac{2}{15}$
2	9		$\frac{11}{80}$
3	–		$\frac{6}{40}$ or $\frac{3}{20}$
3	6		$\frac{7}{40}$
3	8		$\frac{11}{60}$
4	6		$\frac{9}{40}$
4	8		$\frac{7}{30}$
5	4		$\frac{8}{30}$ or $\frac{4}{15}$
5	6		$\frac{11}{40}$
7	4		$\frac{11}{30}$

s.	d.		£.
7	6	is	$\frac{3}{8}$
8	–		$\frac{2}{5}$
8	4		$\frac{5}{12}$
11	8		$\frac{7}{12}$
12	–		$\frac{3}{5}$
12	6		$\frac{5}{8}$
13	4		$\frac{2}{3}$
15	–		$\frac{3}{4}$
16	–		$\frac{4}{5}$
16	8		$\frac{5}{6}$
17	6		$\frac{7}{8}$
18	4		$\frac{11}{12}$

Tenths of 1£.

2s.	is	$\frac{1}{10}$
4		$\frac{2}{10}$ or $\frac{1}{5}$
6		$\frac{3}{10}$
8		$\frac{4}{10}$ or $\frac{2}{5}$
10		$\frac{5}{10}$
12		$\frac{6}{10}$ or $\frac{3}{5}$
14		$\frac{7}{10}$
16		$\frac{8}{10}$ or $\frac{4}{5}$
18		$\frac{9}{10}$

d.		s.
$10\frac{1}{2}$	is	$\frac{7}{8}$
10	–	$\frac{5}{6}$
9	–	$\frac{3}{4}$
8	–	$\frac{2}{3}$
$7\frac{1}{2}$	–	$\frac{5}{8}$
$4\frac{1}{2}$	–	$\frac{3}{8}$
$5\frac{1}{4}$	–	$\frac{1}{2}$ of $\frac{7}{8}$
$3\frac{3}{4}$	–	$\frac{1}{2}$ of $\frac{5}{8}$
$2\frac{1}{4}$	–	$\frac{1}{2}$ of $\frac{3}{8}$
$\frac{3}{4}$	–	$\frac{1}{2}$ of $\frac{1}{8}$
$\frac{1}{2}$	–	$\frac{1}{2}$ of $\frac{1}{12}$
$\frac{1}{4}$	–	$\frac{1}{4}$ of $\frac{1}{12}$

Having got perfectly well acquainted with the preceding tables, it will be found necessary to get by heart the following

RULE.

If th' given price of *one* is found
Part of a penny, shilling, pound,
Besure divide the quantity
By such a part whate'er it be.

EXAM-

EXAMPLES.

d.

$\frac{1}{4}$	$\frac{1}{4}$	1468 lb. of cast iron (at $\frac{1}{4}$ per lb.	1 $\frac{1}{2}$	$\frac{1}{8}$	512 yards at $\frac{3}{4}$ per (yd.
1 d	$\frac{1}{12}$	367	$\frac{3}{4}$	$\frac{1}{2}$	64
1 s	2|0	3|0–7 d.		2|0	3|2
		£.1–10 s.–7 d. Ans.			£.1 12 s. Answ.

The price being a farthing a pound, the given quantity is consequently so many farthings, & a farthing being $\frac{1}{4}$ of a penny, and a penny the $\frac{1}{12}$ of a shilling, and a shilling the $\frac{1}{20}$ of a pound. therefore the divisors are 4, 12 and 20.

It is very evident that 512 yards at a shilling a yard come to those many shillings, and 1 d. $\frac{1}{2}$, being the $\frac{1}{8}$ of a shilling, and three farthings the $\frac{1}{2}$ of 1 d $\frac{1}{2}$ therefore the quantity is divided by 8 and that quotient (or price at 1 d. $\frac{1}{2}$) by 2 to obtain the answer.

$\frac{1}{2}$	$\frac{1}{2}$	416 lb. at $\frac{1}{2}$ per lb.	1 d.	$\frac{1}{12}$	8412 lb. at 1 d. per lb.
1 d	$\frac{1}{12}$	208		2|0	70|1
		17 s.–4 d. Answer			£35–1 s. Answer

In this example the divisors are 2 and 12, because 2 halfpence make a penny, and 12 pence a shilling.

1 d.	$\frac{1}{12}$	5614 oz. at 1 d. $\frac{1}{4}$ per
		467–10 d.
$\frac{1}{4}$	$\frac{1}{4}$	116–11 $\frac{1}{2}$
	2|0	58|4–9–$\frac{1}{2}$
		£29–4 s. 9 d. $\frac{1}{2}$ Ans.

EXAMPLES.

d.

1 ½ | ⅛ | 814 lb. at 1*d.* ¾ *per* lb.

¼ | ⅙ | 101 – 9*d.*

16 – 11 ½

2|0 11|8 8 ½

£5 18*s.* 8*d.* ½ Anſ.

Three halfpence being the ⅛ of a ſhilling, therefore 814 the given quantity, (which is eſteemed as ſo many ſhillings) is divided by 8, and a farthing being ⅙ of 1*d.* ½, that quotient (or price at 1*d.* ½) is divided by 6, the ſum of which quotients divided by 20 gives the anſwer.

2*d.* | ⅙ | 641 lb at 2*d.* *per* lb

2|0 10|6 – 10*d.*

£5 6*s.* 10*d.* Anſ.

2*d* | ⅙ | 868 oz. at 2*d.* ¼

¼ | ⅛ | 144 8*d.*

18 1

2|0 16|2 9

£8 2*s.* 9*d.* Anſw.

Two-pence being ⅙ of a ſhilling, and a farthing ⅛ of two-pence, therefore 868 the given quantity (which is eſteemed thoſe many ſhillings) is divided by 6, and that quotient by 8, which quotients added together and divided by 20 give the Anſwer.

3*d.* | ¼ | 1416 yards at 3*d.*

2|0 35|4

£17 14*s.* Anſwer

3*d.* | ¼ | 816 oz. at 3*d.* ½ *per* oz.

½ | ⅙ | 204

34

2|0 23|8

£11 18*s.* Anſwer

Here 816 the given quantity is divided by 4, the aliquot part that 3*d* is of a ſhilling, and that quotient by 6 the aliquot part a halfpenny is of 3*d.* for 6 halfpence make three-pence.

EXAMPLES.

4*d*. $\frac{1}{3}$ | 961 lb. at 4*d*. *per* (lb.
2|0 | 32|0 4*d*.
£16 0*s*. 4*d*. Answ.

4*d*. $\frac{1}{3}$ | 5674 at 4*d*. $\frac{3}{4}$
$\frac{1}{2}$ $\frac{1}{8}$ | 1891 4*d*.
$\frac{1}{4}$ $\frac{1}{2}$ | 236 5
118 $2\frac{1}{2}$
2|0 | 224|5 $11\frac{1}{2}$
£112 5 $11\frac{1}{2}$ Answ.

In this example at 4*d*. $\frac{3}{4}$ the divisors are 3, 8 and 2, 4*d*. being the $\frac{1}{3}$ of a shilling, a halfpenny the $\frac{1}{8}$ of 4*d*. and a farthing the $\frac{1}{2}$ of a halfpenny.

4*d*. $\frac{1}{3}$ | 814 ells at 5*d*. *per* (ell.
1 $\frac{1}{4}$ | 271 4*d*.
67 10
2|0 | 33|9 2
£16 19*s*. 2*d*. Answ.

4*d*. $\frac{1}{3}$ | 9160 yards at 5*d*. $\frac{1}{4}$
1 $\frac{1}{4}$ | 3053 4*d*.
$\frac{1}{4}$ $\frac{1}{4}$ | 763 4
190 10
2|0 | 400|7 6
£200 7*s*. 6*d*. Ans.

6*d*. $\frac{1}{2}$ | 1234 at 6*d*.
2|0 | 61|7
£30 17*s*. Answer

6*d*. $\frac{1}{2}$ | 1401 lb. at 6*d*. $\frac{1}{2}$
$\frac{1}{2}$ $\frac{1}{12}$ | 700 6*d*.
58 $4\frac{1}{2}$
2|0 | 75|8 $10\frac{1}{2}$
£37 18*s*. 10*d*. $\frac{1}{2}$

6*d*. $\frac{1}{2}$ | 124 ells at 7*d*. *per* (ell.
1 $\frac{1}{6}$ | 62
10 4*d*.
2|0 | 7|2 4
£3 12*s*. 4*d*. Ans.

EXAMPLES.

4d. / 3	$\frac{1}{3}$ / $\frac{1}{4}$	846 at 7d. $\frac{3}{4}$
		282
$\frac{3}{4}$	$\frac{1}{4}$	211 6d.
		52 10 $\frac{1}{2}$
	2|0	54|6 4 $\frac{1}{2}$
		£27 6s. 4d. $\frac{1}{2}$ Anf.

In this example 846 the given quantity is divided by 3 and 4, the aliquot parts for 7d. and three farthings being $\frac{1}{4}$ of 3d. therefore the quotient of 4 (*viz*. the price at 3d.) is divided by 4, because three farthings is the $\frac{1}{4}$ of three-pence

4d. / 4	$\frac{1}{3}$ / $\frac{1}{3}$	1464 at 8d.
		488
		488
	2|0	97|6
		£48 16s. Anfw.

This example may be very expeditioufly done, by taking the aliquot part of a pound, 8d. being the $\frac{1}{30}$th, fo that by cutting off the cypher, and dividing by 3, the whole is done at once, but in this cafe the quantity is confidered as pounds inftead of fhillings.

8d.	$\frac{1}{30}$	146|4 at 8d.
		£48 16s. Anfw. as (before

6d.		$\frac{1}{2}$	567 at 8d. $\frac{1}{4}$
2		$\frac{1}{3}$	283 6d.
	$\frac{1}{4}$	$\frac{1}{8}$	94 6
			11 9 $\frac{3}{4}$
		2|0	38|9 9 $\frac{1}{4}$
			£19 9s. 9d. $\frac{3}{4}$ Anf.

In this laft example the divifors are 2, 3 and 8, 6d. being $\frac{1}{2}$ of a fhilling, 2d, the $\frac{1}{3}$ of 6d, and a farthing the $\frac{1}{8}$ of 2d.

EXAMPLES.

6d. | 1/2 | 942 yards at 9d.
3 | 1/2 | 471
235 6d.
2|0 | 70|6 6
£35 6s. 6d. Answ.

6d. | 1/2 | 876 at 9d. 1/2
3 | 1/2 | 438
1/2 | 1/6 | 219 -
36 6d.
2|0 | 69|3 6d.
£34 13s. 6d. Answ.

6d | 1/2 | 5432 at 10d.
4 | 1/3 | 2716
1810 8d.
2|0 | 452|6 8d.
£226 6s. 8d. Ans.

6d. | 1/2 | 1980 at 10d. 3/4
3 | 1/2 | 990
1 1/2 | 1/2 | 495
1/4 | 1/6 | 247 6d.
41 3
2|0 | 177|3 9
£88 13s. 9d. Ans.

6d. | 1/2 | 416 lb. at 11d. 1/4 (per lb.
4 | 1/3 | 208
1 | 1/4 | 138 8d.
1/4 | 1/4 | 34 8
8 8
2|0 | 39|0 -
£19 10s. Answer

1s. | 1/20 | 56|8 yards at 12d. (per yd.
£28 8s. Answer

CASE I.

When the given price is more than a shilling, the given quantity stands for shillings; and for what the price exceeds a shilling or 12 pence, take parts as before; but if the whole price makes an even aliquot part of a pound, then divide by that part, if more convenient. The following examples will make this clear and easy.

T

EXAMPLES.

3*d*. $\frac{1}{4}$ | 578 yards at 1*s*. 3*d*.
144 6*d*. (*per* yd.

2|0 | 72|2 6

£36 2*s*. 6*d*. Answ.

Otherwise thus, by taking the aliquot part of a pound.

s d
1|3 $\frac{1}{16}$ | 578

£36 2*s*. 6*d*. as before

6*d*. $\frac{1}{2}$ | 4100 at 1*s*. 7*d*. $\frac{1}{2}$
1 $\frac{1}{2}$ $\frac{1}{4}$ | 2050
512 6*d*.

2|0 | 666|2 6*d*.

£333 2*s* 6*d*. Anf.

Nineteen pence half-penny, (the price in this example) being no aliquot part of a pound therefore parts are taken for 7*d*. $\frac{1}{2}$, and added to the given quantity (being esteemed shillings,) and the sum divided by 20 gives the answer.

1|8 $\frac{1}{12}$ | 5671 at 1*s*. 8*d*.

£472 11*s*. 8*d*. Anf.

In this example the divisor is 12, 1*s*. 8*d*. being the $\frac{1}{12}$ of a pound.

6*d*. $\frac{1}{2}$ | 4162 yards at 1*s*.
4 $\frac{1}{3}$ | 2081 (11*d*. $\frac{3}{4}$
1 $\frac{1}{2}$ $\frac{1}{4}$ | 1387 4*d*.
$\frac{1}{4}$ $\frac{1}{6}$ | 520 3 = $\frac{1}{4}$ of 2081
86 8 $\frac{1}{2}$

2|0 | 823|7 3 $\frac{1}{2}$

£411 17*s*. 3*d*. $\frac{1}{2}$ A.

2*s*. $\frac{1}{10}$ | 516|8 ells at 2*s*. *p*.

£516 16*s*. (ell.

Otherwise thus,
5168
2

2|0 | 1033|6

£516 16*s*. as above

In the first operation of this example at 2*s*. you need only double the last figure in the quantity for shillings, the rest are pounds.

EXAMPLES.

2|6 ⅛ 549 at 2*s.* 6*d.*

£68 12*s.* 6*d*, Anſ.

5*s.* ¼ 546 at 5*s*, 4*d.* ½

4*d.* $\frac{1}{60}$ 136 10*s.*

½ $\frac{1}{480}$ 9 2

1 2 9*d.*

£146 14*s.* 9*d.* Anſ.

Here the aliquot parts of a pound are taken, but it may be done otherwiſe, as under.

4*d.* ⅓ 546

5

2730

½ ⅛ 182

22 9*d.*

2|0 293|4 9*d.*

£146 14*s.* 9*d.* Anſ.

By this method you are only to multiply the quantity by the number of ſhillings in the price, and take parts for the remainder of the price as before taught. This method I prefer as much eaſier than the other.

s d

6|8 ⅓ 548 at 6*s.* 8*d.*

£182 13*s.* 4*d.* Anſ.

s.

10 ½ 618 *C.* at 10*s.* *per* (*C.*

£309 Anſwer

s.

10 ½ 876 at 12*s.* 6*d.*

s d

2|6 ¼ 438

109 10*s.*

£547 10*s.* Anſwer

s.

10 ½ 814 at 14*s.*

4 ⅕ 407

162 16*s.*

£569 16*s.* Anſwe

OBSERVATION.

When the price is any even number of ſhillings, you need only multiply the quantity by half the price, and double the firſt figure in the product for ſhillings. Take the laſt example *viz.*

EXAMPLES.

814 at 14*s*.
7

£569 16*s*. Answer

Remark.

This method being *very expeditious* when the price is any even number of shillings, therefore take another example when the multiplier consists of two places.

916 at 56*s*.
28

732 16*s*.
1832

£2564 16*s*. Answ.

Proof of this examp.

916
56

5496
4580

2|0) 51296

£2564 16*s*.

CASE 2.

When you have a certain sum of money in pounds, and desire to know what quantity of goods may be bought therewith, at so many even shillings *per* lb. &c. you need only annex a cipher to the money, and divide by half the proposed price.

EXAMPLE.

How many pounds of tea may be bought for £86, at 4*s*. *per* lb?

2) 860

Answ. 430 lb.

EXAMPLE 2.

How many hogs can I buy for £56 at 16*s*. *per* hog?

8) 560

Answer 70 hogs.

EXAMPLES.

814 oxen at 16*l*.
16 (*per* ox.

4884
814

£13024 Answer

To work this and such like examples, is no more than multiplying the quantity by the price, the *product* being the answer, but if there be any odd money, proceed as before directed by taking parts for the same.

s *d*
3|4 1/6 146 *C*. at 4*l*. 3*s*. (4*d*.
4

584
24 6*s*. 8*d*.

£608 6*s*. 8*d*. Ans.

4*d*. 1/6 804 at 2*l*. –*s* 4*d*.
2

1608
13 8*s*.

£1621 8*s*. Answer

CASE 3.

When the price is any odd number of shillings, multiply the quantity by half the greatest even part of shillings, double the first figure for shillings, and for the odd shilling take 1/10 of the quantity.

1*s*. 1/20 516 at 15*s*.
7

361 4*s*.
25 16

£387 Answer

1*s*. 1/20 814 sheep at 19*s*. *p*. (sheep
9

732 12*s*.
40 14

£773 6*s*. Answer

CASE 4.

If the given price be such a fractional part of a pound, shilling &c. that the *numerator* or top figure is more than an unit, then multiply the

EXAMPLES.

the given quantity by such *numerator* or top figure, and divide the product by the *denominator* or lower figure. A few examples will make this plain and easy.

s.
15 | $\frac{3}{4}$ 516 at 15*s.* *viz.* the (last exam (but one.
3
4 | 1548
£387 Answer

Note, 15*s.* being $\frac{3}{4}$ of a pound, the given quantity is multiplied by 3, and that product divided by 4, which gives the answer the same as before.—Again take an example on *page* 219 *viz.*

s. d.
12|6 | $\frac{5}{8}$ 876 at 12*s.* 6*d.*
5
8 | 4380
£547 10*s.* Answ. as (before

10*d.* | $\frac{5}{6}$ 5432 at 10*d.* *
5
6 | 27160 * *see p.* 217
2|0 | 452|6—8*d.*
£226 6*s.* 8*d.* Ans.

Note, after the same manner may any other example be done, when the price consists of such fractional parts as before mentioned.

CASE 5.

If the price is less than a pound or shilling by any single aliquot part, you may take that aliquot part of the quantity, and subtract it there-from, and the remainder will be the answer.

To illustrate this take the last example but two *viz.*

s.
$\frac{1}{4}$ | 516 at 15*s.*
129 subtract
£387 Answer

Examples.

Again take another example on *p.* 222 *viz.*

5*s.*	$\frac{1}{4}$	876 at 12*s.* 6*d.*
s d		
2|6	$\frac{1}{2}$	219
		109 10*s.*
		328 10 subtract
		£547 10*s.* Answer

In this last example parts are taken for 7*s.* 6*d.* and the sum of the quotes subtracted from the quantity leaves the answer.

Take the other example *viz.*

2*d.*	$\frac{1}{6}$	5432 at 10*d.*
		905 4*d.*
	2|0	452|6 8
		£226 6*s.* 8*d.* Answ.

Note. After the same manner you may proceed with any other example of this kind.

C A S E 6.

When the given quantity consists of integers and fractional parts, multiply the price by the number of integers; and divide the odd quantity or fractional part into aliquot parts of the integer, or of each other, which being done add them all up together.

A Table *of Aliquot Parts of a C. Weight.*

lb.		C. wt.		lb.		
56	is	$\frac{1}{2}$		4	is	$\frac{1}{28}$
28	–	$\frac{1}{4}$		$3\frac{1}{2}$	–	$\frac{1}{32}$
16	–	$\frac{1}{7}$		2	–	$\frac{1}{56}$
14	–	$\frac{1}{8}$		$1\frac{3}{4}$	–	$\frac{1}{64}$
8	–	$\frac{1}{14}$		1	–	$\frac{1}{112}$
7	–	$\frac{1}{16}$				

Note. Aliquot parts of most other things being easily found, it would be needless to say any thing more in this place, concerning them.

EXAMPLES.

		C.	*qrs.*		*£.* *s.*
		8	1	at at	1 16 *per C.*
		£.	*s.*		
qr 1	$\frac{1}{4}$	1	16		
			8		
		14	8		
		0	9		
		£14	17	Anfwer	

In this example the price is multiplied by 8, and divided by 4, the aliquot part for one quarter.

16 *C.* 2 *qrs.* 8 ℔. at £2 4*s.* 1*d.* *per C.* weight.

		£.	*s.*	*d.*		*C.*	*qrs.*	*lb.*
qrs 2	$\frac{1}{2}$	2	4	1				
				8				
		17	12	8	the price 8 *C.*			
				2				
lb. 8	$\frac{1}{7}$	35	5	4	the price of	16	–	–
		1	2	$0\frac{1}{2}$		–	2	–
		–	3	$1\frac{3}{4}$		–	–	8
		£36	10	$6\frac{1}{4}$	the price of	16	2	8

EXAMPLES.

.2|6	$\frac{1}{8}$	249 *C.* 3 *qrs.* 10 *lb.* ½ at £3 2*s.* 8*d. per C.*							
		3				£*1 11 4 price of ($\frac{1}{2}$ *C.*			
		747							
2*d.*	$\frac{1}{15}$	31	2	6					
		2	1	6					
							C.	*qrs.*	*lb.*
qr.		780	4	–			249	–	–
1	$\frac{1}{2}$	*1	11	4			–	2	–
7*lb*	$\frac{1}{4}$	–	15	8	the price of		–	1	–
3½*lb*	$\frac{1}{2}$	–	3	11			–	–	7
		–	1	11½			–	–	3½
		£782	16	10½	the price of		249	3	10½

		3 *qrs.* 16 *lb.* ½ at £6 12*s. per C.*					
qrs		£.	*s.*				
2	$\frac{1}{2}$	6	12				
						qrs.	*lb.*
1	$\frac{1}{2}$	3	6			2	–
14*lb*	$\frac{1}{2}$	1	13			1	–
2	$\frac{1}{7}$	–	16	6	the price of	–	14
$\frac{1}{2}$	$\frac{1}{4}$	–	2	4¼		–	2
		–	–	7		–	½
		£5	18	5¼	the price of	3	16½

EXAMPLES.

lb. oz. dwt. £. s.
20 1 6 at 4 10 *per* lb.

oz.		£.	s.						
1	$\frac{1}{12}$	4	10						
			10						
		45							
		2							
							lb.	oz.	dwt.
dw		90	–	–	the price of		20	–	–
4	$\frac{1}{5}$	–	7	6	the price of		–	1	–
2	$\frac{1}{2}$	–	1	6	the price of		–	–	4
		–	–	9	the price of		–	–	2
		£20	9	9	the price of		20	1	6

£. s. d.
6 yds. 2 qrs. 2 nls. at 1 2 6 *per* yard.

						yds.	qrs.	nls.
qr.		£.	s.	d.				
2	$\frac{1}{2}$	1	2	6				
				6				
nl.		6	15	–	the price of	6	–	–
2	$\frac{1}{4}$	–	11	3	the price of	–	2	–
		–	2	$9\frac{3}{4}$	the price of	–	–	2
		£7	9	$0\frac{3}{4}$	the price of	6	2	2

EXAMPLES.

SCHOLIUM.

According to the foregoing reafoning and method of calculation, any thing may be done that may occur in *Practice;* and to conclude this excellent compendium of arithmetic called *Practice*, I fhall here prefent my readers with fome articles therein, lately received from my generous and worthy friend Mr. *P. Antrobus*, Mafter of *Middlewich* Grammar School *Chefhire*, they are as follow.

A new eafy and coneife method of folving any queftion in *Practice*, whether it relates to weight, meafure, or time; by reducing the weight meafure or time into money, and finding the price at two fhillings, whatever the given price is.

RULE.

Double the right hand figure of the given number (whofe price is fought) for fhillings, the reft are pounds. Admit 364 yards of cloth be fold for 2*s*. *per* yard; here the right hand figure 4 being doubled is 8, and the remainder 36, I account *l* 36, therefore the amount of 364 yards at 2*s*. *per* yard, is £36 8*s*. Now if one yard coft 2*s*, a quarter will coft 6*d*, therefore 364 $\frac{1}{4}$ yards at 2*s*. *per* yard, will coft *l* 36 9*s*. 6*d*. and if one quarter coft 6*d*. then half a quarter will coft 3*d*, &c. Whence 186 *C*. 3 *qrs*. 14 *lb*. at 2*s*. *per C*. will coft £18 13*s*. 9*d*. and in like manner for any other cafe whether weight meafure or time.

Hence when you have converted your weight meafure or time into money, multiply the money fo converted by half the pounds and fhillings reduced into fhillings, and take parts of 2*s*. for the pence &c as before, add all together and you have the anfwer.

But to find more eafily the price of any number of pounds at 2*s* *per C* account the given pounds as fo many farthings, and fubtract the 7th, part thereof from the faid farthings, the remainder will be the price in farthings.

EXAMPLE.

EXAMPLE.

What cost 24 lb. at 2*s.* *per* C.

7)	24
subtract	$3\frac{3}{7}$
Answer	$20\frac{4}{7}$ farthings

Thus 256 C. 3 qrs. 24 lb. at 2*s.* *per* C. comes to £25 13*s.* 11*d.*–$\frac{4}{7}$

EXAMPLE 2.

What cost 326 lb. at $\frac{3}{4}$ *per* pound?

		£.	s.	
6*d.*	$\frac{1}{4}$	32	12	
$\frac{3}{4}$	$\frac{1}{8}$	8	3	
		1	–	$4\frac{1}{2}$

Here you see doubling the last figure gives the price at 2*s.* Then taking any even part of 2*s.* as here, 6*d.* is $\frac{1}{4}$ gives £8 3*s.* the price at 6*d.* then $\frac{3}{4}$ being $\frac{1}{8}$ of 6*d.* I take the $\frac{1}{8}$ thereof and it gives the answer, and so in the other examples following.

EXAMPLE 3.

What cost 274 yards at 5*d.* *per* yard?

4*d.*	$\frac{1}{6}$	27	8	
1*d.*	$\frac{1}{4}$	4	11	4
		1	2	10
Ans.		5	14	2

EXAMPLE 4.

What come 36 days wages to at 2*s.* 2*d.* *per* day?

36 days wages are equal to £3 12*s.* at 2*s.* *per* day.

$\frac{1}{12}$ for 2*d.* is		6
Answer	3	18

EXAMPLE

EXAMPLE 5.

What cost 171 lb. 2 oz. 18 dwt. at £5 8*s.* *per* pound?

lb. oz. dwt. £. *s.* *d.* £. *s.*

171 2 18 equal to 17 2 5 $\frac{1}{4}$ $\frac{3}{5}$ at 2*s* *per lb.* 5 8

54 20

68 9 11 $\frac{4}{5}$ 2) 108

856 4 2

12) 50 54

Answer £924 14 1 $\frac{4}{5}$

2|0) 12|4 2

6 4 2

EXAMPLE 6.

What cost 171 *C.* 1 *qr.* 4*lb.* at £3 1*s.* 4*d.* *per* *C.* weight Averdupoise?

C. *qr.* *lb.* £. *s.* *d.*

171 1 4 equal to 17 2 6 $\frac{3}{4}$ $\frac{3}{7}$ at 2*s.* *per* C.

30 $\frac{1}{2}$

£. *s.*

3 1 513 17 1 $\frac{1}{2}$ $\frac{6}{7}$ = 30 times ⎧ the

20 8 11 3 $\frac{1}{4}$ $\frac{5}{7}$ = $\frac{1}{2}$ of ⎨ price

2) 61 2 17 1 $\frac{4}{7}$ = $\frac{1}{6}$ ⎩ at 2*s.*

Answ. 525 5 6 $\frac{1}{4}$ $\frac{1}{7}$

30$\frac{1}{2}$ No. of 2*s.*

(in £3 1*s.*

7) 20

4) 22 $\frac{6}{7}$

12) 85 $\frac{1}{2}$

2|0) 7|7 1

£3 17 1 $\frac{1}{2}$ $\frac{6}{7}$

Note. That the learner may not be unacquainted with the method of working these examples, I shall add the following EXPLANATION.

The meaning of this division with the work in the operation is thus performed.

First $30 \times \frac{3}{7} = \frac{90}{7} = 12\frac{6}{7}$ farthings, then $30 \times \frac{3}{4} + 12 = \frac{102}{4}$ farthings $= 25d.\ \frac{1}{2}$, and $30 \times 6 + 25d. = \frac{205}{12}d. = 17s.\ 1d.$ then $30 \times 2s. = £3$, whence we have £3 17*s*. 1*d*. $\frac{1}{2}\frac{6}{7}$. Lastly $17 \times 30 = 510$, which add to £3 17*s*. 1*d*. $\frac{1}{2}\frac{6}{7}$ makes £513 17*s*. 1*d*. $\frac{1}{2}\frac{6}{7}$, the next line is found by taking $\frac{1}{2}$ of the price at 2*s*, for the $\frac{1}{2}$, and last of all $\frac{1}{8}$ of the price of 2*s*. for the 4*d*. which sums being all added together make the answer as before.

EXAMPLE 7.

What is the yearly Rent of 107 acres 2 roods at 45*s*. *per* acre?

a.	rds.		£.	s.	d.	
107	2	equal to	10	15		at 2*s* *per* acre.
				22 $\frac{1}{2}$		half value
			21	10		
			215	–		
			5	7	6	
		Answer	£241	17	6	

2|0) 10|0
5

EXAMPLE 8.

What cost 107 barrels 9 gallons of ale or beer, at 31*s*. *per* barrel?

bar.	g.		£.	s.	d.
107	9	=	10	14	6 $\frac{1}{4}\frac{7}{17}$
					15 $\frac{1}{2}$
			53	12	7 $\frac{3}{4}\frac{1}{17}$
			107	5	3 $\frac{1}{2}\frac{2}{17}$
			5	7	3 $\frac{12}{17}$
		Answer	£166	5	2 $\frac{1}{4}\frac{15}{17}$

2) 21*s*.
$15\frac{1}{2}$
17) 70
4) $14\frac{2}{17}$
12) $63\frac{1}{2}$
2|0) 14|5 3
7–5–3 $\frac{1}{2}$

Note. More examples might be added but these are sufficient to shew the method.

TARE

TARE and TRET.

SIX terms are in this rule combin'd
To be observed as you'll find;
Gross, Tare, Tret, Suttle, Cloff, Neat-weight,
Which must be us'd to work it right.

1. *Gross*, is the whole weight of any commodity be what it will, with the hogshead, chest &c. that contains it.

2. *Tare* is an allowance made by the *King* to the *Importer*; or by the *Merchant* to the *Buyer* for the weight of the bag, cask, chest, wrapper &c. in which any goods are packed up.—In a book intitled *The Book of Rates*, there is a table in which several sorts of goods have their Tares ascertained.

3. *Tret* is an allowance generally made by the *Merchants* of *London* to their *Tradesmen*, &c. for waste and dust in *Tobacco*, *Spices*, *Drugs*, &c. being 4 ℔. in 104 ℔. *viz.* $\frac{1}{26}$ part of the whole, after the Tare is deducted.

4. *Suttle*, is the weight of the goods when only the Tare is taken out, and not the Tret.

5. *Cloff* is an allowance made also by the *Citizens* of *London*, for the turn of the scale, *viz.* 2 ℔. for every 3 *C.* weight, or as some say for 3 *C.* 1 qr. 8 ℔.

6. *Neat-weight* is the weight of any goods, when all allowances are deducted.

First. *When the* Neat-weight *of any goods is required, and only* Tare *allowed; observe the following*

RULE.

From the *Gross weight* deduct the *Tare*,
And the *Neat weight* will then appear.

EXAMPLE 1.

If I buy 114 *C.* 1 *qr.* 20 *lb.* of Tobacco or any other goods, and am allow'd 1 *C.* 2 *qrs.* 4 *lb.* Tare, what is the neat weight?

	C.	*qr.*	*lb.*	
From the gross	114	1	20	
Deduct the tare	1	2	4	
Remains	112	3	16	neat

EXAMPLE 2.

In 8 bags of hops each weighing gross 3 *C.* 2 *qrs.* 15 *lb.* tare 12 *lb.* *per* bag. How much neat weight?

	lb.	
Tare *per* bag	12	
Number of bags	8	
		qrs.
28)	96	(3
	84	
	12 *lb.*	

	C.	*qrs.*	*lb.*	
	3	2	15	
			8	
From	29	—	8	gross
Take	—	3	12	tare
Answ.	28	—	24	

EXAMPLE 3.

In 310 *C.* 1 *qr.* 16 *lb.* gross, tare 16 *lb.* *per* *C.* What is the neat?

lb.	*C.*	*qr.*	*lb.*
16 is 7)	310	1	16
Tare	44	1	10 $\frac{1}{4}$
Answ.	266	1	10 $\frac{3}{4}$

Note. In dividing by 7 there remains 2 *lb.* *viz.* 8 *qrs.* which being divided by 7, quotes a quarter and 1 remains, and which may be rejected as inconsiderable.

EXAM-

EXAMPLE 4.

What is the neat weight of 4 casks of Raisins, each cask weighing,

		C.	qrs.	lb.	
No.	1	2	2	14	lb.
	2	3	1	10	Tare 12 *per C.*
	3	2	3	16	how much neat ?
	4	1	3	24	

	C.	qrs.	lb.		
lb. 14 is $\frac{1}{8}$)	10	3	8	the whole gross	
lb. 2 is $\frac{1}{7}$)	1	1	$11\frac{1}{2}$	the tare at	*lb.* 14
Deduct	–	–	$21\frac{1}{2}$		2
Remains	1	–	18		12 *per C.*

	C.	qrs.	lb.
From the whole gross	10	3	8
Deduct the tare	1	–	18
Remains neat	9	2	18

2d. *When* Tret *is allowed with* Tare, *observe the following*

RULE:

From the whole *Gross* deduct the *Tare*,
And th' *Suttle weight* will then appear,
Which weight by twenty-six divide;
The quote's the *Tret*, and then beside
Deduct it from the *Suttle weight*,
And the remainder is the *Neat*.

EXAMPLE I.

In 12 *C.* 1 *qr.* 18 *lb.* groſs, tare 40 *lb.* tret 4 *lb.* *per* 104. How much neat weight?

```
                    C.  qr.  lb.
                    12   1   18
                     4
                    --
                    49
                    28
                   ---
                   400
                    99
                  ----
From the groſs    1390
Deduct the tare     40
                  ----
             26) 1350 (51¾ Tret
                 130
                 ---
                  50
                  26
                  --
                  24
                   4
                  --
              26) 96 (¾
                  78
                  --
                  18
                  --
```

EXAM-

From Suttle		1350
Deduct Tret		$51\frac{3}{4}$
28 {	4)	$1298\frac{1}{4}$
	7)	324–2 } lb.
	4)	46–2 } 10
Answer		*C.* 11–2–10 $\frac{1}{4}$

Or thus,

	C.	*qr.*	*lb.*
From gross	12	1	18
Deduct 40*lb.* the tare)	–	1	12
26)	12	–	6 sut.
Deduct	–	1	$23\frac{3}{4}$ tr.
Remains	11	2	$10\frac{1}{4}$ nt.

Example 2.

In 121 *C.* 2 *qr.* 4*lb.* gross, tare 8 *lb.* *per C.* tret 4*lb.* *per* 104. What is the neat weight?

lb.		*C.*	*qrs.*	*lb.*	
16 is $\frac{1}{7}$)		121	2	4	gross
8 is $\frac{1}{2}$)		17	1	$12\frac{1}{2}$	} the tare at { 16 / 8 } *lb.* *per C.*
	From gross deduct	8	2	$20\frac{1}{4}$	}
26)		112	3	$11\frac{3}{4}$	suttle
	Deduct	4	1	10	tret
	Answer	108	2	$1\frac{3}{4}$	neat

3*d. When* Cloff *is allowed with* Tare *observe the following*

RULE.

Suttle and *Tret*,—found as before,
Another Suttle will make more,
From which deduct the *Cloff* besure,
And the *Neat weight* you will procure.

EXAM-

EXAMPLE 1.

In 14 *C.* 2 *qrs.* 10 *lb.* gross. tare 2 *C* 3 *qrs.* 14 *lb.* tret 4 *lb.* *per* 104 *lb.* and cloff 2 *lb.* for 3 *C.* What is the neat weight?

From the gross	14	2	10
Take the tare	2	3	14
26)	11	2	24
Deduct the tret	–	1	$22\frac{3}{4}$
2d. suttle	11	1	$1\frac{1}{4}$
Deduct the cloff	–	–	7
Remains neat	11	–	$22\frac{1}{4}$

Cloff is found by multiplying the 2d. suttle by 2, and dividing that product by 3, or divide the 2d. suttle by 3 the quotient will be double pounds in the cloff, or otherwise it may be found by dividing the pounds in the 2d suttle by 168, *two pounds* being the 168th part of 3 *C.* weight.

C.
11
2
3) 22
lb. $7\frac{1}{3}$ * Cloff

C.
3) 11
lb. $3\frac{2}{3}$ double *lbs.* = $7\frac{1}{3}$ as before

Or 1232 the pounds in 11 *C.* (the 2d. suttle) divided by 168 quotes $7\frac{56}{168} = 7\frac{1}{3}$ as above.

EXAMPLE 2.

What is the neat weight of 2 hogsheads of tobacco weighing

	C.	*qrs.*	*lb.*	
No. 1	5	3	10	gross
2	4	1	12	gross
wh. gross	10	–	22	

Tare 7 *lb. per C.* tret 4 *lb. per* 104, and cloff 2 *lb. per C.* weight.

* What odd weight remains in finding *Cloff* is inconsiderable and need not be noticed.

	C.	qrs.	lb.			
7 is $\frac{1}{16}$)	10	–	22	gross		
Deduct	–	2	$15\frac{1}{4}$	tare		
26)	9	2	$6\frac{3}{4}$			C.
Deduct	–	1	13	tret		9
						2
	9	–	$21\frac{3}{4}$	2d. suttle		
Deduct	–	–	6	cloff	3)	18
Neat	9	–	$15\frac{3}{4}$			6 cloff.

S C H O L I U M.

I hope by this time I have given sufficient examples to make my ingenious readers thoroughly acquainted with *Tare* and *Tret*, and shall now proceed to Bills of Parcels and Book Debts.

Bills of Parcels and Book Debts.

Litchfield 21st, *Feb.* 1772.

Mrs. *Jane Poimore*

Bought of *Humphrey Hosier*.

					£.	s.	d.
8	Pair of Silk Stockings at 10*s*. 6*d*. *per* pair				4	4	–
5	—— Worsted ditto	3	4	–	–	16	8
4	—— Thread –	5	–	–	1	–	–
16	—— Yarn –	1	10	–	1	9	4
18	—— Cotton –	4	6	–	4	1	–
9	—— Women's Silk Gloves	4	3	–	1	18	3
20	Yards of Flannel –	1	6	*per* yd	1	10	–
					£14	19	3

The Honourable Lady *Pink*,

To *Anne Milliner* Dr.

1772 *London*

		s.	d.	£	s.	d.
Jan. 12:	To fine Lace 12 yds at	10	4 *p.* yd	6	4	–
	Flower'd Ribbon, 10½ at	2*s*	6*d*	1	6	3
14:	Sarcenet Hoods 6¾ at	4*s*	–	1	7	–
24:	Kid Gloves 8 pair at	2*s*	1*d p.* pair	–	16	8
Feb. 1:	Lambs ditto 2 doz. at	12*s*	*per* doz.	1	4	–
Mar. 18:	*India* Fans 6 doz. at	4*s*	1*d*	1	4	6
				£12	2	5

Whitchurch 4th, *February* 1772.

Peter Paywell Esq.

Bought of *John Woollendraper*.

			£	s.	d.
10	yards of fine broad cloth	at 12*s* 6*d per* yd.	6	5	–
6	—— superfine ditto	at 17*s* 1*d* –	5	2	6
14	—— drugget ¾ wide	at 5*s* 4*d*	3	14	8
~~18~~	~~—— yard wide~~	~~4*s* 1*d*~~	~~3~~	~~13~~	~~6~~
10	—— serge –	at 3*s* —	1	10	–
40	—— Shalloon –	at 1*s* 6*d*	3	–	–
			£23	5	8

Whitchurch 11th, of *March* 1772.

Mrs. *Townley*

Bought of *Edmund Linendraper*.

			£	s.	d.
30	Ells of dowlas at 1*s* 6*d per* ell	—	2	5	–
60	—— diaper at 1*s* 6*d* ½	—	4	12	6
12½	yards *Irish* cloth at 3*s* 2*d per* yard		1	19	7
16	—— of muslin at 8*s*	—	6	8	–
14	—— cambric 11*s* 4*d*	—	7	18	8
34	—— printed linen 2*s* 6*d*	—	4	5	–
			£27	8	9

Sir *Sampson Rock*, Bart.

To *Zachary Sugarloaf* Dr.

1772		£	s.	d.
Jan. 4:	To 8½ lb. of raisins at 6*d* ½ *per* lb	–	4	7¼
12:	16 lb. of currants at 4*d*	–	5	4
	20 lb. of *Malaga* raisins 5*d*¾	–	9	7
	7 lb. of rice 4*d* —	–	2	4
Feb. 14:	4 lb. of pepper at 1*s* 6*d*	–	6	–
Mar. 6:	6 sugar loaves, wt. 60 lb. at 9*d*	2	5	–
18:	7 oz. of cloves at 1*s* 4*d*	–	9	4
		£4	2	2¼

London 7*th*, of *March* 1772.

Simon Bateman Esq.

Bought of *Roger Wineseller*.

				£	s.	d.
Port red	15	gallons at 6*s* 4*d* *per* gal.		4	15	–
Claret	20	——— 9*s* 2*d*	—	9	3	4
Palm Sack	4	——— 7*s* 10*d*	—	1	11	4
Lisbon white	40	——— 4*s* 3*d*	—	8	10	–
Sherry	21	——— 5*s* 10*d*	—	6	2	6
Rhenish	24	——— 6*s* 2	—	7	8	–
				£37	10	2

Chester 12th, *May* 1772.

Mr. *Ambrose Cob*

Bought of *John Cornchandler*.

	qrs.	bu.		£	s.	d.		£	s.	d.
Wheat	5	2	at	2	18	8	*per* qr.	15	8	–
Rye	9	6	at	1	14	–	—	16	11	6
Oats	10	4	at	–	14	8	—	7	14	–
Beans	–	10	at	–	4	2	*per bush.*	2	1	8
Peas	–	12	at	–	3	1	—	1	17	–
								£43	12	2

Mrs. *Anne Wheedle*

To *Arthur Mercer* Dr.

		s.	d.	£.	s.	d.
1771						
Feb. 7 :	To 16 yards of ſilk at	14	6 *per* yd.	11	12	–
	14 — flower'd dit	16	–	11	4	–
Nov. 24 :	12 — brocade	12	4	7	8	–
1772 *April* 16 :	18 yds. luteſt.	7	–	6	6	–
Auguſt 15 :	5 velvet	19	6	4	17	6
28 :	14 ſattin	10	6	7	7	–
				£48	14	6

		£	s.	d.			
1771							
June 28 :	By caſh receiv'd	15	4	6			
Nov. 24 :	Bill on *Davies* & *Long*	8	18	6			
1772 *May* 2 :	Caſh —	7	14	–			
					31	17	–
	Balance due				£16	17	6

London 6th, *Feb.* 1772.

Mr. *Swithin Shakeſpear*

Bought of *Charles Cheeſemonger*

	C.	qr.	lb.		£.	s.	d.		£.	s.	d.
12 *Cheſhire* cheeſes	6	1	14	at	1	18	6	*per*	12	5	$5\frac{1}{4}$
16 *Glouceſter* ditto	4	–	16	at	1	16	–	—	7	9	$1\frac{1}{2}$
40 *Stilton* ditto	1	1	4	at	2	12	8	—	3	7	$8\frac{1}{2}$
10 Flitches of bacon 60 ſtone						6	4	*per* ſt.	19	–	–
20 Firkins of *Iriſh* butter at £1 2*s* each fir.									22	–	–
									£64	2	$3\frac{1}{4}$

Salop March 12th, 1772.

Mr. *Job Standfast*

Bought of *James Ray*, 4 casks of sugar.

	C.	qrs.	lb.			qrs.	lb.	
No. 1.	5	3	12			qrs.	lb.	
2.	6	2	16	Tare		2	26	each cask.
3.	7	1	11				4	
4.	8	1	14					
					C. 2	3	20	whole tare
Gross	28	–	25					
Tare	2	3	20					
Neat	25	1	5	at 2*l*. 4*s*. *p*. *C*.	£55	12	11½	

Form of a Carpenter's Bill from the celebrated Mr. *George Bickham's* Universal Penman.

Conrade Dubois Esq. Dr.

To *Henry Sims* for work and materials in his House at *Henley-Park Surry*.

1738			£	s.	d.
May	18 :	Oak tim. 12 load at 2 5 (£. s.) a ton	33	15	–
	27 :	Fir tim. 35 t. at 1*l* 12*s* 10*d* a ld.	45	19	4
June	11 :	Oak plank 96 foot – 3½*p*. ft.	1	8	–
	15 :	*Norw* deals 590 at 6*l* 15*s* *p*. hd.	33	3	9
	29 :	Sixpenny nls. 29 tho. 3*s* 10*d* *p*. m.	5	11	2
		Ten groat nls 30 do. 14*s* 10*d* do.	22	5	–
July	16 :	Work for self 90 days 3*s* 4*d* *p*. day	15	–	–
		— for 1 man 90 do. 2*s* 6*d* –	11	5	–
		Wainscot 73 yds. 3*s* 2*d* *p*. yard	11	11	2
		Double quarter 58 feet 4*d*. *p*. foot	–	19	4
			£180	17	9

Note. Deals and Nails are 120 to the hundred, 50 feet are a load, and 40 feet a ton of timber.

VULGAR FRACTIONS.

FRACTIONS direct you very clear,
When parts of Integers appear;
How to proceed, their value find,
Tho' e'er so variously combin'd.

NOTATION.

Any unit or integer, divided into parts is expressed by two numbers thus $\frac{3}{4}$, the lower number is called the *denominator*, and the upper the *numerator*, which shews how many parts of the denominator the given fraction consists of. The denominator denotes how many equal parts, any integer or quantity is supposed to be divided into; and is no more than a *divisor* in *simple Division*.

Fractions are either *proper*, *improper*, or *compound*.

When the numerator is less than the denominator it expresses a *simple single* or *proper fraction* as $\frac{1}{2}$, $\frac{3}{4}$, $\frac{6}{9}$, $\frac{12}{120}$ &c.

When the numerator is equal to or greater than the denominator, it denotes an *improper fraction* as $\frac{5}{5}$, $\frac{6}{3}$, $\frac{12}{4}$, $\frac{164}{91}$ &c.

When several fractions come together, coupled or joined with the particle *of* as $\frac{2}{3}$ *of* $\frac{3}{4}$ *of* $\frac{4}{6}$ (*read or verbally express'd thus, two thirds of three fourths of four sixths*) they are *compound fractions* or *fractions of fractions*, and to render this more plain and conspicuous, admit a pound sterling to be divided in this manner.

	s.	d.		
6)	20			
	3	4	$=\frac{1}{6}$	of a £.
		4		
4)	13	4	$=\frac{4}{6}$	
	3	4	$=\frac{1}{4}$	of $\frac{4}{6}$ of a £.
		3		
3)	10	–	$=\frac{3}{4}$	
	3	4	$=\frac{1}{3}$	of $\frac{3}{4}$ of $\frac{4}{6}$ of a £.
		2		
	6	8	$=\frac{2}{3}$	

A whole number with a fraction annexed, is called a *Mixt number* and is expressed thus $12\frac{3}{4}$ *viz.* 12 units and $\frac{3}{4}$ of a unit, *i. e.* a unit is broken or divided into 4 parts, and 3 of those parts must be taken to add to the whole number 12.

Reduction of Vulgar Fractions.

CASE I.

To reduce any given fraction *to another of* equal value.

RULE.

Both terms divide or multiply
By the same number, you'll espy
A *fraction* new,—whose value's even
Equivalent to what was given.

EXAMPLE.

Suppose the *fraction* be $\frac{5}{8}$ now according to the *rule* multiply the given fraction by 6, *i. e.* both numerator and denominator must be multiplied thereby. *See the work.*

$$\begin{array}{cc} 5 & 8 \\ 6 & 6 \\ \hline 30 & 48 \end{array}$$

Whence the new fraction is $\frac{30}{48} = \frac{5}{8}$. again divide both terms of the new fraction by 6. 6) $\frac{30}{48}$ ($\frac{5}{8}$ the fraction proposed.

CASE 2.

To reduce any whole number *into the form of a* fraction.

RULE:

Be the *whole number* great or small,
Write down a *unit* under all.

This is no more than under any whole number, as 6, 8, 12 &c, to write down a unit, and you have the fractional quantity. As $\frac{6}{1}$, $\frac{8}{1}$, $\frac{12}{1}$ &c.

CASE 3.

To reduce any whole number *to a* fraction *of a* given denomination.

RULE.

By the denominator you,
Must multiply your number true;
Under the product, *Tyro* see,
That your denominator be.

EXAMPLE.

Reduce 12 into a fraction whose denominator shall be 9.

$$\begin{array}{r} 12 \\ 9 \\ \hline 108 \end{array}$$

108 Numerator, then $\frac{108}{9}$ is the fraction required.

CASE 4.

To reduce a compound fraction *to a* single-one *of the same value.*

RULE.

Now all the numerators see,
They multipli'd together be;
Work the denominators so,
The single fraction then you'll know.

EXAMPLE.

Reduce $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{5}{7}$ to a single or simple fraction.

$$\begin{array}{ll} 2 & 3 \\ 3 & 4 \\ \hline 6 & 12 \\ 5 & 7 \\ \hline 30\ N. & 84\ D. \end{array}$$

Whence $\frac{30}{84}$ is the fraction required;

Note, *N* stands for numerator, and *D* for denominator.

COROLLARY.

The above *compound fraction* may be reduced to a *single one*, by cancelling or rejecting such numerators as are equal to or divisible by any of the denominators; and here it may be observed, that the denominator of the 2d, fraction is divisible by the numerator of the 1st, and the numerator of the 2d, by the denominator of the 1st, then $2 \times 7 = 14$ *D*. and 5 is the *N*. as above, which fraction is equal to $\frac{30}{84}$ by the rule in *page* 243

CASE 5.

To reduce any mixt number *to an* improper fraction.

RULE.

By the denominator you
Must multiply th' whole number true;
Unto the product, likewise add
Your numerator—then is had
A numerator, new and clear,
As underneath is made t' appear.

EXAMPLE.

Reduce $24\frac{4}{9}$ to an improper fraction.

$24\frac{4}{9}$
9

220 *N.* therefore $\frac{220}{9}$ is the fraction required.

Note. After the same manner may any *mixt number* be reduced to an *improper fraction*.

CASE 6.

To reduce an improper fraction *to its* equivalent, whole *or* mixt number.

RULE.

Divide the numerator true
By the denominator, you
Th' integral part will fairly see,
And if remainders any be,
O'er the divisor place the same,
And you the fractional part may name.

EXAMPLE 1.

Reduce $\frac{220}{9}$ to its equivalent whole or mixt number.

9) 220

Answ. $24\frac{4}{9}$

EXAMPLE 2.

Reduce $\frac{780}{12}$ to its equivalent whole or mixt number.

12) 780

Answ. 65

Note. This and the five *preceding cases* are so easy, that any more examples therein wou'd be prolixity only.

CASE

CASE 7.

To find the greatest common measure *or* divisor *for the numerator and denominator of any given* fraction, *or* for any two numbers.

RULE.

The greatest term by th' least divide,
Th' divisor by what remains beside;
And thus proceed 'till nought remains,
The measure's found with little pains.

EXAMPLE.

What is the greatest common measure of $\frac{124}{216}$?

```
124) 216 (1
     124
     ---
      92) 124 (1
           92
          ---
           32) 92 (2
               64
               --
               28) 32 (1
                   28
                   --
                    4) 28 (7
                       28
                       --
                        0
                       --
```

Answ. 4 is the greatest number or common measure that will divide both numerator and denominator without a remainder.

When there are mixt numbers given, they must be reduced to a common denominator, then proceed with the two new numerators to find their greatest common measure, make that the numerator, and under put the common denominator, which fraction will be the greatest common measure sought or required.

EXAMPLE

What is the greatest common measure of $7\frac{2}{4}$ and 16?

First, these are to be reduced to a common denominator as before explain'd, thus

$$
\begin{array}{llll}
 & 7\frac{1}{2} & 16 & \\
30)\ 64\ (2 & 4 & 4 & \frac{30}{4} \text{ and } \frac{64}{4} \\
\quad 60 & \overline{30\ N.} & \overline{64\ N.} & \\
\quad \overline{\quad 4)\ 30\ (7} & & & \\
\qquad\quad 28 & & & \\
\qquad \overline{\quad 2)\ 4\ (2} & & & \\
\qquad\qquad 4 & & & \\
\qquad\qquad \overline{\cdot} & & &
\end{array}
$$

Answ. $\frac{2}{4}$ is the greatest common measure of $7\frac{2}{4}$ and 16.

CASE 8.

To reduce a fraction to its least *or* lowest terms.

RULE.

The *greatest common measure* * find,
By which divide both terms combin'd,
Of any *fraction*,—then most sure,
The quotients will the terms procure.

EXAMPLE I.

Reduce $\frac{204}{228}$ to its least terms.

$$
\begin{array}{l}
204)\ 228\ (1 \\
\quad\ \ 204 \\
\quad\ \ \overline{\ 24)\ 204\ (8} \\
\qquad\quad\ \ 192 \\
\qquad\quad\ \ \overline{\ 12)\ 24\ (2} \\
\qquad\qquad\quad\ \ 24 \\
\qquad\qquad\quad\ \ \overline{\cdot}
\end{array}
\qquad \frac{12}{12})\ \frac{204}{228}\ (\frac{17}{19} \text{ Answer}
$$

* If the *common measure* happens to be an unit, the fraction is in its *lowest terms* already.

EXAM-

EXAMPLE 2.

Reduce $\frac{1656}{1932}$ to its lowest terms.

$$\begin{array}{r}
1656)\ 1932\ (1 \\
1656 \\
\hline
276)\ 1656\ (6 \\
1656 \\
\hline
\cdot
\end{array}$$

$\frac{276}{276})\ \frac{1656}{1932}\ (\frac{6}{7}$ Answer

SCHOLIUM.

To abbreviate any given fraction which is divisible by any number as 2, 3, 4, 5, 6, 7, &c.—The fraction is easily reduced to its least terms, by dividing both the numerator and denominator by such a number, as evidently appears by the following

EXAMPLES.

Reduce $\frac{44}{112}$ into its least terms.

This fraction halved is $\frac{22}{56}$ which being also halved is $\frac{11}{28}$, and is of equal value to the given fraction $\frac{44}{112}$.

Reduce $\frac{65}{80}$ into its least terms.

This fraction ending with 5 and a cipher is divisible by 5. 5) $\frac{65}{80}$ ($\frac{13}{16}$ Answer

Reduce $\frac{318}{612}$ into its least terms.

This fraction it is plain is divisible by 3) $\frac{318}{615}$ ($\frac{106}{205}$.

Reduce $\frac{100}{2400}$ to its least terms.

By cutting off the ciphers the fraction will stand in its lowest terms, thus $\frac{1}{24}$.

CASE 9.

To reduce fractions *of unequal or different denominators to* those *of equal value with a common denominator.*

RULE

RULE.

The numerator multiply,
Of ev'ry fraction that is by,
Into th' denominators clear,
Except its own, there will appear
New numerators,—lastly do,
Multiply th' denominators so,
Into each other and you'll see
A new denominator 'll be.

EXAMPLE 1.

Reduce $\frac{2}{4}$, $\frac{3}{9}$ $\frac{6}{12}$ into fractions of one common denominator.

2	3	6	4
9	4	9	9
18	12	54	36
12	12	4	12
216 *N.*	144 *N.*	216 *N.*	432 *D.*

Whence $\frac{2}{4} = \frac{216}{432} = \frac{6}{12}$ and $\frac{3}{9} = \frac{144}{432}$.

EXAMPLE 2.

Reduce $14\frac{2}{3}$, 7 and $\frac{2}{3}$ of $\frac{5}{8}$ of $\frac{3}{9}$ and $\frac{4}{7}$ to fractions of one common denominator.

First $14\frac{2}{3} = \frac{44}{3}$, $7 = \frac{7}{1}$, and the compound fraction $\frac{2}{3}$ of $\frac{5}{8}$ of $\frac{3}{9} = \frac{30}{216} = \frac{5}{36}$ in its lowest terms. *Then* the fractions to be reduced to a common denominator are $\frac{44}{3}$, $\frac{7}{1}$, $\frac{5}{36}$ and $\frac{4}{7}$.

44	7	5	4	3
1	3	1	36	1
44	21	5	144	3
36	36	3	1	36
264	126	15	144	108
132	63	7	3	7
1584	756	105 *N.*	432 *N.*	756 Com. denom.
7	7			
11088 *N.*	5292 *N.*			

Anſwer $\frac{11088}{756} = \frac{44}{3} = 14\frac{2}{3}$, $\frac{5292}{756} = \frac{7}{1} = 7$, $\frac{105}{756} = \frac{5}{36} = \frac{2}{3}$ of $\frac{5}{8}$ of $\frac{3}{9}$, and $\frac{432}{756} = \frac{4}{7}$.

Note. It frequently happens that fractions may be reduced to a common denominator, *more eaſily and in far leſs terms*, than by the general method of involving the numerator of each fraction into the denominators of all the others, &c. As ſuppoſe the fractions $\frac{3}{50}$ and $\frac{1}{40}$ were to be reduced to a common denominator, by the general method the common denominator will be 2000 but it is very obvious that by the rule in *page* 243 theſe fractions may be reduced to *ſuch* whoſe common denominator will be but 200 for $\frac{3}{50}$ multiplied by 4 and $\frac{1}{40}$ by 5 produce $\frac{12}{200}$ and $\frac{5}{200}$ and which are equivalent or equal in value to $\frac{120}{2000}$ and $\frac{50}{2000}$ the fractions when reduced by the common method.—Again, admit $\frac{1}{3}$, $\frac{3}{8}$ and $\frac{5}{12}$ were to be reduced to a common denominator, by the general method the common denominator will be 288 but it may be eaſily diſcovered that theſe fractions may (by the aforeſaid rule in *page* 243) be reduced to *ſuch* whoſe common denominator will be but 24 for by multiplying $\frac{1}{3}$ by 8, $\frac{3}{8}$ by 3, and $\frac{5}{12}$ by 2 they will become

become $\frac{8}{24}$, $\frac{9}{24}$ and $\frac{10}{24}$, and which are equivalent to $\frac{96}{288}$, $\frac{108}{288}$ and $\frac{120}{288}$ the fractions when reduced the common way.—And the fractions of the *first example* of *this Case*, *viz.* $\frac{2}{4}$, $\frac{3}{9}$ and $\frac{6}{12}$ being abbreviated become $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{2}$ and which by this method may be reduced to *such* whose common denominator will be 6, for the two fractions $\frac{1}{2}$ and $\frac{1}{2}$ being severally multiplied by 3, and $\frac{1}{3}$ by 2 make $\frac{3}{6}$, $\frac{2}{6}$ and $\frac{3}{6}$ and which (as may be seen in *page* 250) are equivalent to $\frac{216}{432}$, $\frac{144}{432}$ and $\frac{216}{432}$ the fractions when reduced the common way, so that by proceeding after this manner (where the case will admit) a multiplicity of figures and tedious work will be saved.

And here it will be very necessary to acquaint the learner (*what most authors have omitted*) that if one fraction be equivalent to another it will hold, as the numerator of the *one* is to its denominator so is the numerator of the *other* to its denominator, or, as one numerator to the *other* so is one denominator to the *other*. And also the numerator of the *one* multiplied by the denominator of the *other*, will be equal to the denominator of the *one* multiplied by the numerator of the *other*.—And now admit it was required to know whether the last mentioned fraction in the *second example* of this *case viz.* $\frac{432}{756}$ be equal (as it is there said to be) to $\frac{4}{7}$, it certainly is, for 432 multiplied by 7 is equal to 756 multiplied by 4.—Or (by the *common Rule of Three*) as 432 (the numerator of the one fraction) is to 756 (its denominator) so is 4 (the numerator of the *other*) to 7 its denominator.—Or as 432 is to 4 so is 756 to 7 the denominator as before. And it is plain that the fraction $\frac{4}{7}$ is equal to $\frac{432}{756}$ for as 4 is to 7 so is 432 to 756, so that by any of these methods, it may be easily known whether any one fraction be equivalent to another, without finding their respective values in the known parts of the integer.

CASE

CASE 10.

To reduce coins, weights, measures *&c. into* fractions.—Suppose 6*s.* and 4*d.* were to be reduced to the fraction of a pound *Sterling*. This is no more than to make the pence in 6*s.* and 4*d.* the numerator to 240 the pence in a pound.

s. d.
6 4
12
—
76 *N*. Then $\frac{76}{240}$ is the fraction required $= \frac{19}{60}$ in its lowest terms.

EXAMPLE 2.

Reduce 6*d* $\frac{1}{2}$ to the fraction of a shilling.

6 $\frac{1}{2}$
2
—
13 *N*. Answ. $\frac{13}{24}$
—

EXAMPLE 4.

Reduce 2 R. 14pls. to the fraction of an acre.

2 r. 14 pls.
40
—
94 *N*. Answ. $\frac{94}{160} = \frac{47}{80}$ in its least terms.)
—

EXAMPLE 3.

Reduce 4*C.* 1 *qr.* 12 *lb.* to a fraction of 1 *C.* weight

C. qr. lb.
4 1 12
4
—
17
28
— Answ. $\frac{488}{112} = \frac{61}{14}$ in its least terms.
138
35
—
488 *N*.
—

Note. After the same manner may any other weights, measures &c. be reduced to fractions.

CASE 11.

When fractions are to be reduced *to other equivalent ones*, of a different integer, *i. e.* when the given fraction is to be brought from a greater to a less denomination, or from a less to a greater, observe the following

RULE.

If a less denomination's sought,
From any greater to be brought,
The *numerator* multiply
By th' integral parts, you'll soon descry
A numerator new and clear,
To its denominator there.
And when a greater you require,
To multiply you must prepare
Th' *denominator* by those parts,
This do, and master be of arts.

EXAMPLE 1.

Reduce $\frac{4}{16}$£. to an equivalent fraction of a penny.

$$\begin{array}{r} 4 \\ 20 \\ \hline 80 \\ 12 \\ \hline 960\ N. \end{array}$$

Answ. $\frac{960}{16} = \frac{60}{1}$ in its least terms.)

EXAMPLE 3.

Reduce $\frac{3}{7}$ lb Troy to the fraction of a pennyweight.

$$\begin{array}{r} 3 \\ 12 \\ \hline 36 \\ 20 \\ \hline 720\ N. \end{array}$$

Answ. $\frac{720}{7}$

EXAMPLE 2.

Reduce $\frac{8}{12}$ of a shilling to the fraction of a farthing.

$$\begin{array}{r} 8 \\ 12 \\ \hline 96 \\ 4 \\ \hline 384\ N. \end{array}$$

Answ. $\frac{384}{12} = \frac{192}{6} = \frac{96}{3} = \frac{32}{1}$.

EXAMPLE 4.

Reduce $\frac{6}{8}$ of a shilling to the fraction of a pound.

$$\begin{array}{r} 8 \\ 20 \\ \hline 160 \end{array}$$

Answ. $\frac{6}{160} = \frac{3}{80}$ in its lowest terms)

EXAM-

EXAMPLE 5.

Reduce $\frac{18}{160}$ of a farthing, to the fraction of a pound.

160
4
———
640
12
———
7680
20
———
153600 *D.*

Answ. $\frac{18}{153600}$ = $\frac{3}{25600}$ in its least terms

EXAMPLE 6.

Reduce $\frac{4}{12}$ of lb to the fraction of a *C.* weight.

12
28
———
336
4
———
1344 *D.*

Answ. $\frac{4}{1344} = \frac{1}{336}$ in its lowest terms.
Or otherwise by compound fractions.
$\frac{4}{12}$ of $\frac{1}{28}$ of $\frac{1}{4}$ = $\frac{4}{1344}$ as before.

EXAMPLE 7.

Reduce $\frac{3}{4}$ of a pound to the fraction of a guinea.

3	4
20	21
60 *N.*	84 *D.*

Answ. $\frac{60}{84} = \frac{30}{42} = \frac{15}{21} = \frac{5}{7}$ in its least terms.

EXAMPLE 8.

Reduce $\frac{5}{7}$ of a guinea to the fraction of a pound.

5	7
21	20
105 *N.*	140 *D.*

Answ. $\frac{105}{140} = \frac{21}{28} = \frac{3}{4}$ in its lowest terms.

CASE 12.

To find the value of any fraction in money, weight or measure.

RULE.

The numerator multipli'd
By th' integer—then next divide
The product true, be what it will,
By th' denominator still.
Th' remainder too, reduce as low
As th' lowest terms are pleas'd to go.

Y 2 EXAM-

EXAMPLE 1.

Required the value of $\frac{157}{192}$ of a pound *Sterling.*

```
        157
         20
       ----    s
192)  3140  (16
      192
      ----
      1220
      1152
      ----
        68
        12
      ----     d
192)   816  (4
       768
      ----
        48
         4
      ----
192)   192  (1/4
       192
      ----
         .
```

Answ. £— 16s 4d $\frac{1}{4}$

EXAMPLE 4.

What is the value of $\frac{5}{8}$ of 8s 10d?

```
     s    d
     8   10
          5
   ---------
8)  2  4  2
   ---------
   s5  6d 1/4
```

EXAMPLE 2.

What is the value of $\frac{7}{9}$ of a guinea?

```
      21
       7
     ----
9)   147
     ----
Answ. s16 4d
```

EXAMPLE 3.

What is the value of $\frac{4}{9}$ of a pound *Avoirdupoise?*

```
      4
     16
     ---
9)   64
     ---
     7 oz. 1 dr. 7/9
```

EXAMPLE 5.

What is the value of $\frac{4}{18}$ of an acre?

```
          4
          4
        ---
         16
         40
        ---
18{ 3)  640
  { 6)  213-1 }
        ---    } 10
         35-3 }
```

Ans. 35 $\frac{10}{18}$ pls. = 35 $\frac{5}{9}$ pls.

After

After the same manner may the value of any fraction be found, but there is another method whereby the value may be easily exhibited, which is (as in *page* 243) to divide the integer by the denominator, and to multiply that quotient by the numerator: As suppose the value of $\frac{7}{9}$ of a guinea was required, now 21 shillings (a guinea) being divided by 9, the denominator of the fraction, quotes 2*s* and 4*d* (the 9th of a guinea) which being multiplied by the numerator 7, produces 16*s* and 4*d* the answer the same as in *page* 256.

ADDITION of VULGAR FRACTIONS.

RULE.

THE numerators first be sure
To add, and then you will procure
A numerator, new and fair,
Under the same you must take care,
To write down clear to public view
Th' common denominator true.

SCHOLIUM.

In *Addition* or *Subtraction* of *Vulgar Fractions* observe, that all *Compound Fractions* must be reduced to *simple ones*, and all to the same integer and denominator, if they are of different denominations.

EXAMPLE 1.

What is the sum of $\frac{5}{18}$ and $\frac{7}{18}$?

To 5
Add 7

12
— Answ. $\frac{12}{18} = \frac{2}{3}$ in its least terms.

EXAMPLE 2.

What is the sum of $\frac{4}{11}$ and $\frac{9}{11}$?

To 4
Add 9

13
— Answ. $\frac{13}{11} = 1\frac{2}{11}$

Example 3.

What is the ſum of $\frac{5}{6}$ and $\frac{5}{7}$?

5	5	6
7	6	7
—	—	—
35 *N.*	30 *N.*	42 *D.*

Then the fractions to be added are $\frac{35}{42}$ and $\frac{30}{42}$ whoſe *ſum* is $\frac{65}{42} = 1\frac{23}{42}$.

Example 4.

Add $\frac{1}{2}$, $\frac{3}{4}$ and $\frac{3}{5}$ together.

Theſe fractions reduced to a common denominator (by the *note* to *caſe* 9 *page* 251) are $\frac{10}{20}$, $\frac{15}{20}$ and $\frac{12}{20}$ which being added together make $\frac{37}{20} = 1\frac{17}{20}$ Anſ.

Example 5.

What is the ſum of $\frac{3}{5}$ of $\frac{4}{6}$, $\frac{2}{7}$ and $1\frac{1}{4}$?

Firſt $\frac{3}{5}$ of $\frac{4}{6} = \frac{12}{30} = \frac{2}{5}$ and $1\frac{1}{4} = \frac{5}{4}$

Then $\frac{2}{5}$, $\frac{2}{7}$ and $\frac{5}{4}$ reduced to a common denominator are $\frac{56}{140}$, $\frac{40}{140}$ and $\frac{175}{140}$ whoſe *ſum* is $\frac{271}{140} = 1\frac{131}{140}$.

Example 6.

Add $14\frac{7}{8}$, $23\frac{1}{4}$ and $26\frac{5}{9}$ together.

There are two ways whereby this and ſuch like queſtions may be done, one whereof is to reduce the mixt numbers to improper fractions, and thoſe to a common denominator. The other is only to reduce the fractional parts of the mixt numbers to fractions of one common denominator, and to add their ſum to the whole or integral parts, and which is far more preferable than the firſt method, by ſaving a multiplicity of figures as may be ſeen by the following operations.

Method 1.

Firſt $14\frac{7}{8} = \frac{119}{8}$, $23\frac{1}{4} = \frac{93}{4}$ and $26\frac{5}{9} = \frac{239}{9}$

Then $\frac{119}{8}$, $\frac{93}{4}$ and $\frac{239}{9}$ reduced to fractions of a common denominator (by the *note* to *caſe* 9 *page* 251) are $\frac{1071}{72}$, $\frac{1674}{72}$ and $\frac{1912}{72}$ the ſum whereof is $\frac{4657}{72} = 64\frac{49}{72}$ Anſwer.

Method

Method 2.

First, the fractions in this example *viz.* $\frac{7}{8}$, $\frac{1}{4}$ and $\frac{5}{9}$ reduced to fractions of a common denominator (by the *Note* to *Case* 9 *page* 251) are $\frac{63}{72}$, $\frac{18}{72}$ and $\frac{40}{72}$ which being added together make $\frac{121}{72} = 1\frac{49}{72}$. *Then* $1\frac{49}{72}$ (the sum of the fractions) added to the whole numbers 14, 23 and 26 make $64\frac{49}{72}$ the answer as before.

EXAMPLE 7.

What is the sum of $\frac{5}{6}$ of a *moidore*, $\frac{5}{6}$ of a *pound* and $\frac{7}{9}$ of *half a guinea*.

First $\frac{5}{6}$ of a moidore = to the compound fraction $\frac{5}{6}$ of $\frac{27}{20} = \frac{135}{120}$ £. and $\frac{7}{9}$ of half a guinea = to the compound fraction $\frac{7}{9}$ of $\frac{1}{2}$ of $\frac{21}{20} = \frac{147}{360} = \frac{49}{120}$ £. Now these two fractions $\frac{135}{120}$ and $\frac{49}{120}$ have a common denominator, and by multiplying the *other viz.* $\frac{5}{6}$ £. by 20 (*see Case* 1 *page* 243) it will have the same denominator (as the other two fractions) by becoming $\frac{100}{120}$ *Then* the fractions to be added are $\frac{135}{120}$, $\frac{49}{120}$ and $\frac{100}{120}$ whose *sum* is $\frac{284}{120} = \frac{71}{30}$ = £2 7*s.* 4*d.*

EXAMPLE 8.

Admit I sail where billows roar,
  And plow the raging sea,
And steering to a *foreign* shore,
  A prize falls in my way;
When having chang'd a full broad side,
  As *Anson* us'd to do,
Or *Drake*, and many more beside,
  Who boldly dar'd the foe.
Suppose this prize ten thousand pound,
  Three fiftieths is my share,
Another Sailor's share is (found
  His part) *two eightieths* (are)
I purchase *this* then what's to me,
  The total worth define,
And you shall with *Minerva* be,
  And in her temple shine.

First

First $\frac{2}{80}$ (the purchased share) $= \frac{1}{40}$ *then* $\frac{3}{50}$ and $\frac{1}{40}$ reduced to a common denominator (see the *note* to *case* 9 *page* 251) make $\frac{12}{200}$ and $\frac{5}{200}$ whose sum is $\frac{17}{200}$. And to find the value of $\frac{17}{200}$ of £ 10000 (the whole prize) proceed thus

```
        10000
           17
        ------
  2|00) 1700|00
        ------
Answer £ 850
        ------
```

But this question may be easily answered by finding the value of $\frac{3}{50}$ and also the value of $\frac{1}{40}$ of £ 10000 separately and adding them together,

See the work.

```
  4|0) 1000|0
            3
       ------
  5|0) 3000|0
       ------
```

To 600	} the {	Sailor's own share	
Add 250		purchased one	

Answer £850 the same as before.

SUBTRACTION of VULGAR FRACTIONS.

RULE.

AS in *Addition* first prepare,
Your fractions with peculiar care,
Of both the numerators see,
The difference deducted be,
And a new numerator then
Is found—now *Tyro* take your pen,
And under this besure to write,
Th' common denominator straight.

EXAM-

Exam. 1.		Exam. 2.		Exam. 3.		Exam. 4.	
From	$\frac{19}{67}$	From	$\frac{17}{85}$	From	$14\frac{15}{19}$	From	$98\frac{15}{17}$
Take	$\frac{13}{67}$	Take	$\frac{14}{85}$	Take	$8\frac{4}{19}$	Take	$89\frac{9}{17}$
Anf.	$\frac{6}{67}$	Anf.	$\frac{3}{85}$	Anfw.	$6\frac{11}{19}$	Anf.	$9\frac{6}{17}$
Proof	$\frac{19}{67}$	Proof	$\frac{17}{85}$	Proof	$14\frac{15}{19}$	Proof	$98\frac{15}{17}$

Example 5.

	£.
From	$576\frac{15}{27}$
Take	$458\frac{16}{27}$
Anfw.	$117\frac{26}{27}$
Proof	$576\frac{15}{27}$

To work this example, fay 16 from 15 I cannot, but 27 (the parts the integer is divided into) that I borrow to 15 is 42, 16 from 42 and there remains 26, which fet down as a numerator to the denominator 27, and carry 1 to the 8 and proceed as in *common fubtraction* and the anfwer or remainder will be $117\frac{26}{27}$ as above.

Example 6.

Subtract $\frac{4}{6}$ of $\frac{2}{10}$ from $\frac{2}{3}$.

First $\frac{4}{6}$ of $\frac{2}{10} = \frac{2}{3}$ of $\frac{1}{5} = \frac{2}{15}$

Then (by *cafe* 1 *page* 243) $\frac{2}{3} = \frac{10}{15}$ from which fubtract $\frac{2}{15}$ (the $\frac{4}{6}$ of $\frac{2}{10}$) and the *remainder* will be $\frac{8}{15}$.

Example 7.

Subtract $12\frac{3}{4}$ from $16\frac{1}{3}$

First $12\frac{3}{4} = \frac{51}{4}$, and $16\frac{1}{3} = \frac{49}{3}$.

Then fubtract $\frac{51}{4}$ from $\frac{49}{3}$.

51	49	4
3	4	3
153 *N.*	196 *N.*	12 *D.*

From	196
Take	153
Rem.	43

Anfw. $\frac{43}{12} = 3\frac{7}{12}$.

Or

Or thus.

First, the fractions in this example *viz.* $\frac{3}{4}$ and $\frac{1}{3}$ reduced to a common denominator are $\frac{9}{12}$ and $\frac{4}{12}$ which being added to their respective whole numbers make $12\frac{9}{12}$ and $16\frac{4}{12}$ then

From	$16\frac{4}{12}$	
Take	$12\frac{9}{12}$	
Answ.	$3\frac{7}{12}$	as before.

MULTIPLICATION of VULGAR FRACTIONS.

RULE.

ALL th' numerators multiply
Together, and you'll soon espy
Your numerator, very clear,
As quickly will be made t' appear,
Next the denominators too,
Thus multipli'd together shew
The fraction fair, I tell you true.

EXAMPLE 1.

Multiply $\frac{3}{4}$ by $\frac{5}{8}$

$$\begin{array}{ll} 3 & 4 \\ 5 & 8 \\ \hline 15\ N. & 32\ D. \end{array}$$

Answ. $\frac{15}{32}$

EXAMPLE 2.

Multiply $\frac{4}{16}$ by $\frac{12}{42}$

First $\frac{4}{16} = \frac{1}{4}$, and $\frac{12}{42} = \frac{2}{7}$

Then the fractions to be multiplied are $\frac{1}{4}$ and $\frac{2}{7}$.

$$\begin{array}{ll} 1 & 4 \\ 2 & 7 \\ \hline 2\ N. & 28\ D. \end{array}$$

Anf. $\frac{2}{28} = \frac{1}{14}$

EXAMPLE

EXAMPLE 3.

Multiply $\frac{6}{7}$ by $\frac{3}{4}$ of $\frac{4}{5}$
First $\frac{3}{4}$ of $\frac{4}{5} = \frac{12}{20} = \frac{3}{5}$
Then the fractions to be multiplied are $\frac{6}{7}$ and $\frac{3}{5}$.

6   7
3   5
18 *N.*   35 *D.*

Answ. $\frac{18}{35}$.

EXAMPLE 4.

£   £
Multiply $5\frac{3}{6}$ by $7\frac{2}{3}$.
First $5\frac{3}{6} = 5\frac{1}{2} = \frac{11}{2}$, and $7\frac{2}{3} = \frac{23}{3}$
Then, the fractions are $\frac{11}{2}$ and $\frac{23}{3}$.

11   2
23   3
253 *N.*   6 *D.*

Answ. $\frac{253}{6}$ (= £42 $\frac{1}{6}$ = £42 3s 4d

EXAMPLE 5.

Multiply $6\frac{3}{4}$ by $\frac{4}{5}$ and that product by 7 and *that* by $\frac{2}{3}$ of $\frac{3}{4}$.
First $6\frac{3}{4} = \frac{27}{4}$, $7 = \frac{7}{1}$ and $\frac{2}{3}$ of $\frac{3}{4} = \frac{6}{12} = \frac{1}{2}$.
Then the example will stand thus, multiply $\frac{27}{4}$ by $\frac{4}{5}$ and that product by $\frac{7}{1}$ and *that* by $\frac{1}{2}$.

27   4
4   5
108   20
7   1   Answ. $\frac{756}{40} = \frac{189}{10} = 18\frac{9}{10}$.
756   20
1   2
756 *N.*   40 *D.*

DIVISION of VULGAR FRACTIONS.

RULE.

BE your divisor what it will
And dividend, observe me still;
Each numerator multiply,
In each denominator by—
Crossways and you'll the quotient find,
Complete as hereunto's subjoin'd.

SCHOLIUM.

Fractions in *Division* must be prepared by *Reduction*, the same as in the other rules, *i. e. Compound Fractions* must be reduced to *simple ones*, *mixt numbers* into *improper Fractions*, *whole numbers* express'd Fractionwise, &c.

EXAMPLE 1.

Divide $\frac{4}{8}$ by $\frac{2}{7}$

$\frac{2}{7}$) $\frac{4}{8}$ ($\frac{28}{16} = 1\frac{12}{16} = 1\frac{3}{4}$ Answer.)

EXAMPLE 3.

Divide $\frac{16}{112}$ by $\frac{4}{8}$

$\frac{4}{8}$) $\frac{16}{112}$ ($\frac{4}{14} = \frac{2}{7}$ Answ.

EXAMPLE 2.

Divide $\frac{8}{12}$ by $\frac{3}{9}$

$\frac{3}{9}$) $\frac{8}{12}$ ($\frac{72}{36} = 2$ Answ.

EXAMPLE 4.

Divide $\frac{28}{108}$ by $\frac{7}{12}$

$\frac{7}{12}$) $\frac{28}{108}$ ($\frac{4}{9}$ Answer.

In

In this example, the numerator and denominator of the dividend, are both divisible by their respective terms in the divisor, and therefore bring out the answer as in example 3, and is the same *but in far less terms* than if multiplied cross-wise thus,

$\frac{4}{8}$) $\frac{16}{112}$ ($\frac{128}{448} = \frac{2}{7}$ as before

EXAMPLE 5.

Divide $\frac{3}{4}$ of $\frac{2}{5}$ by $\frac{4}{8}$

First $\frac{3}{4}$ of $\frac{2}{5} = \frac{6}{20}$ $\frac{3}{10}$ the dividend.

And $\frac{4}{8} = \frac{1}{2}$ the divisor

Then $\frac{1}{2}$) $\frac{3}{10}$ ($\frac{6}{10} = \frac{3}{5}$ Ans.

EXAMPLE 6.

Divide $\frac{1}{2}$ of $\frac{3}{4}$ by $\frac{2}{5}$ of $\frac{6}{8}$.

First $\frac{1}{2}$ of $\frac{3}{4} = \frac{3}{8}$, and $\frac{2}{5}$ of $\frac{6}{8} = \frac{12}{40} = \frac{3}{10}$

Then $\frac{3}{10}$) $\frac{3}{8}$ ($\frac{30}{24} = 1\,\frac{6}{24}$ $= 1\,\frac{1}{4}$ Answ.

EXAMPLE 7.

Divide 12 $\frac{3}{4}$ by $\frac{4}{7}$.

First 12 $\frac{3}{4} = \frac{51}{4}$

Then $\frac{4}{7}$) $\frac{51}{4}$ ($\frac{357}{16} = 22$ $\frac{5}{16}$ Answ.

EXAMPLE 8.

Divide 6 $\frac{3}{4}$ by $\frac{3}{4}$ of $\frac{2}{5}$.

First 6 $\frac{3}{4} = \frac{27}{4}$, and $\frac{3}{4}$ of $\frac{2}{5} = \frac{6}{20} = \frac{3}{10}$

Then $\frac{3}{10}$) $\frac{27}{4}$ ($\frac{270}{12} = \frac{135}{6} = 22\,\frac{3}{5}$ Answ.

EXAMPLE 9.

Divide $\frac{6}{7}$ by 4.

$\frac{4}{1}$) $\frac{6}{7}$ ($\frac{6}{28} = \frac{3}{14}$

EXAMPLE 10.

Divide 12 by 3 $\frac{4}{5} = \frac{19}{5}$

$\frac{19}{5}$) $\frac{12}{1}$ ($\frac{60}{19} = 3\,\frac{3}{19}$ Ans.

EXAMPLE 11.

Divide $\frac{3}{4}$ of a *pound* by $\frac{2}{3}$ of a *shilling*.

First $\frac{2}{3}$ of a shilling = $\frac{1}{30}$ of a pound

Then $\frac{1}{30}$) $\frac{3}{4}$ ($\frac{90}{4} = \frac{45}{2} =$ £22 10*s*. Answ.

EXAMPLE 12.

Divide $\frac{2}{3}$ of a *shilling* by $\frac{3}{4}$ of a *pound*.

First $\frac{2}{3}$ *s* = £ $\frac{1}{30}$ as before,

Then $\frac{3}{4}$) $\frac{1}{30}$ ($\frac{4}{90} = \frac{2}{45}$ £ = 10*d*. $\frac{1}{2}$ $\frac{10}{15}$

SCHOLIUM.

I shall now proceed to the *Rule of Three*, having given various examples, in *this*, whereby it may be easily observed that *Division of Fractions* is only to

Z reduce

reduce the given fractions (*being simple or improper ones*) to a common denominator, and to make a fraction of the new numerators, (*that* of the divisor being made the denominator) which fraction is the quotient sought, and must be reduced as the nature of the case may require.

RULE of THREE in VULGAR FRACTIONS.

RULE.

PREPARE your Fractions,–state them free,
As in the common Rule of Three;
First term's denominator you,
By th' numerators of th' other two
Must multiply, and then you'll see,
A numerator new will be,
Th' remaining terms next multiply
Th' denominator you'll descry.

EXAMPLE I.

If $\frac{2}{3}$ of a pound of tobacco cost 8*d.* $\frac{3}{4}$. How many pounds may be bought for £25?

First 8*d.* $\frac{3}{4} = \frac{35}{4}$ of $\frac{1}{12}$ of $\frac{1}{20} = \frac{35}{960} = \frac{7}{192}$£ and £25 $= \frac{25}{1}$. *Then* say

$$\text{If } \overset{£.}{\frac{7}{192}} : \overset{lb.}{\frac{2}{3}} :: \overset{£.}{\frac{25}{1}}$$

$$\begin{array}{rr} 2 & 3 \\ 25 & 1 \\ \hline 50 & 3 \\ 192 & 7 \\ \hline 9600\ N. & 21\ D. \end{array}$$

Answ. $\frac{9600}{21} = \frac{3204}{7} =$ (457 lb $\frac{1}{7}$.

Or, reduce the *first* and *third terms* (for the sake of variety) to the fractions of a shilling, and in order to shew that the *Rule of Three in Vulgar Fractions* is exactly the same as the *common one*, (respect being had to the rules in Fractions) multiply the *second* and *third terms* together, divide the product by the *first*, and the quotient will be the answer. *See*

See the work.

First 8*d.* $\frac{3}{4}$ = $\frac{35}{4}$ of $\frac{1}{12}$ = $\frac{35}{48}$*s.* and £25 = $\frac{25}{1}$ of $\frac{20}{1}$ = $\frac{500}{1}$*s.*

$$\begin{array}{lccccccc} & s. & & lb. & & s. & & lb. \\ \textit{Then say If}^{*} & \frac{35}{48} & : & \frac{2}{3} & :: & \frac{500}{1} & & \end{array}$$

$\frac{35}{48}$) $\frac{1000}{3}$ ($\frac{48000}{105}$ = $\frac{3200}{7}$ = 457 $\frac{1}{7}$ (Answer as before.

2	3
500	1
1000 *N.*	3 *D.*

Example 2.

If $\frac{2}{3}$ of a *C.* weight cost £2 6*s.* 8*d.* what will $\frac{6}{7}$ cost?

$$\begin{array}{lccccccc} & C. & & £.\ s.\ d. & & £. & & C. \\ \text{As}^{*} & \frac{2}{3} & : & 2\ 6\ 8 & = & \frac{7}{3} & :: & \frac{6}{7} \end{array}$$

3	7
7	3
21	21
6	2
126 *N.*	42 *D.*

Anf. $\frac{126}{42}$ = (£3.

Note. It may very easily be found that £2 6*s.* 8*d.* is equal to $\frac{7}{3}$ for 6*s.* is $\frac{6}{20}$ of a £ and 8*d.* is $\frac{8}{12}$ of $\frac{1}{20}$ of a £, which reduced to a simple fraction is $\frac{8}{240}$, & by multiplying the other fraction *viz.* $\frac{6}{20}$ by 12 (*see Case* 1 *page* 243) it will have the same denominator as $\frac{8}{240}$ by becoming $\frac{72}{240}$, the sum of which two fractions in its lowest terms is $\frac{1}{3}$, then £2 6*s.* 8*d.* is equal to £2 $\frac{1}{3}$ which being reduced to an improper fraction becomes $\frac{7}{3}$ as above.——But this may be done more readily by *Case* 10 *page viz.* 253 by making 80 the pence in 6*s.* and 8*d.* the numerator to 240 the pence in a pound, thus $\frac{80}{240}$, and which in its lowest terms will be $\frac{1}{3}$ to which prefix 2. the whole number, makes £2 $\frac{1}{3}$ equal to the improper fraction $\frac{7}{3}$ as before.

EXAMPLE 3.

If $\frac{4}{12}$ of a gentleman's estate be worth £400 10*s*. 6*d*. what is $\frac{16}{20}$ of the said estate worth?

First by *Reduction* $\frac{4}{12} = \frac{1}{3}$, £400 10*s*. 6*d*. $= 400\frac{21}{40} = \frac{16021}{40}$, and $\frac{16}{20} = \frac{4}{5}$.

Then say

If* $\frac{1}{3}$: £ $\frac{16021}{40}$ :: $\frac{4}{5}$.

16021	40
4	5
64084	200
3	1
192252 *N.*	200 *D.*

Answ. $\frac{192252}{200} = \frac{48063}{50}$ (= £961 5*s*. 2*d*. $\frac{2}{5}$

This example may be very elegantly solv'd for ($\frac{4}{12}$ being equal to $\frac{1}{3}$ therefore) 3 times £400 10*s*. 6*d*. will be the worth of the whole estate, from which deduct $\frac{1}{5}$ thereof ($\frac{16}{20}$ being equal to $\frac{4}{5}$) and the remainder will be the answer, *see the work.*

	£.	*s*.	*d*.	
	400	10	6	
			3	
5)	1201	11	6	whole estate
Deduct	240	6	$3\frac{3}{5}$	
Answer	£961	5	$2\frac{2}{5}$	as before

EXAMPLE 4.

Some time ago, as people say,
A debt four men agreed to pay
Of just one pound, each share was fix'd,
One third, one fourth, one fifth, one sixth.
Then *Tyro* what was each man's due
Of cash to pay? pray tell me true.

The

The fractions in this example *viz.* $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, and $\frac{1}{6}$, being reduced to a common denominator and added together, the sum will be (in its lowest terms) $\frac{19}{20}$. Then say

1st, If* $\frac{19}{20} : \overset{s.}{\frac{20}{1}} :: \frac{1}{3}$	*2dly*, If* $\frac{19}{20} : \overset{s.}{\frac{20}{1}} :: \frac{1}{4}$
$\frac{19}{20}) \frac{20}{3} (\frac{400}{57} = 7^s - d\ \frac{4}{19}$	$\frac{19}{20}) \frac{20}{4} (\frac{400}{76} = 5^s\ 3^d\ \frac{3}{19}$
3dly, If* $\frac{19}{20} : \frac{20}{1} :: \frac{1}{5}$	*4thly*, If* $\frac{19}{20} : \frac{20}{1} :: \frac{1}{6}$
$\frac{19}{20}) \frac{20}{5} (\frac{400}{95} = 4^s\ 2d\ \frac{10}{19}$	$\frac{19}{20}) \frac{20}{6} (\frac{400}{114} = 3^s\ 6d\ \frac{2}{19}$

Answer			£.	s.	d.
	1st,	man's share	–	7	– $\frac{4}{19}$
	2d,		–	5	3 $\frac{3}{19}$
	3d,		–	4	2 $\frac{10}{19}$
	4th,		–	3	6 $\frac{2}{19}$
		Proof	£1	–	–

Note. In these 4 operations the *second* and *third terms* are multiplied together, and the product divided by the *first*.

Example 5.

Suppose I buy 4 ½ yards of cloth to make a coat, the cloth being 1 ¼ yard wide, how many yards of shalloon of ¾ wide will line the same?

First by *Reduction* $4\frac{1}{2} = \frac{9}{2}$, and $1\frac{1}{4} = \frac{5}{4}$.

Then as $\frac{5}{4} : \frac{9}{2} :: \frac{3}{4}$*

$$\begin{array}{rr} 4 & 4 \\ 9 & 2 \\ \hline 36 & 8 \\ 5 & 3 \\ \hline 180\ N. & 24\ N. \end{array}$$

Answer $\frac{180}{24} = 7\frac{1}{2}$ yards

Or thus

$$\begin{array}{rr} 5 & 4 \\ 9 & 2 \\ \hline 45\ N. & 8\ D. \end{array} \quad \tfrac{3}{4})\tfrac{45}{8}(\tfrac{180}{24}$$

(= 7 ½ as before.

EXAMPLE

Example 6.

Admit 8 men do a certain piece of work in 16 $\frac{3}{4}$ days. How long will 24 men be in doing the same?

As $\frac{8}{1}$: 16 $\frac{3}{4}$ = $\frac{67}{4}$ :: $\frac{24}{1}$

1	1
67	4
67	4
8	24
536 *N.*	96 *D.*

Answer $\frac{536}{96} = 5\frac{7}{12}$ days

Or thus

67	1
8	4
536 *N.*	4 *D.*

$\frac{24}{1}$) $\frac{536}{4}$ ($\frac{536}{96} = 5\frac{7}{12}$ days (as before.

Note. These two last questions are in *Reciprocal Proportion*, as appears by the work.

DOUBLE RULE of THREE, or Rule of FIVE in Vulgar Fractions.

RULE.

YOUR Question stated, next proceed
To multiply your terms with speed,
First the three last, that product you
By th' reciprocals of the other two
Must multiply—the answer fair,
Will for inspection then appear.

Example 1.

If 12 men are hired to do a piece of work in 8 days at 2*s.* 2*d.* *per* day, what will be the wages of 9 men for 20 $\frac{1}{2}$ days?

First

First by *Reduction* the numbers expressed in fractions are $\frac{12}{1}$, $\frac{8}{1}$, 12 men at 2*s* 2*d per* Day = £1 6*s* = £1 $\frac{6}{20}$ = 1 $\frac{3}{10}$ = $\frac{13}{10}$. $\frac{9}{1}$ and $\frac{41}{2}$.

$$\begin{array}{lcr} & \text{m.} & \text{m.} \\ * \frac{12}{1} & \text{———} \frac{13}{10} \text{———} & \frac{9}{1} \\ * \frac{8}{1} & \text{—————————} & \frac{41}{2} \end{array}$$

$$\begin{array}{rr} 9 & 2 \\ 41 & 10 \\ \hline 369 & 20 \\ 13 & 12 \\ \hline 1107 & 240 \\ 369 & 8 \\ \hline 4797\ N. & 1920\ D. \end{array}$$

In this example the multiplying by 1 is omitted for the reason given in *page* 179.

Ans. $\frac{4797}{1920}$ = £2 9*s* 11*d* $\frac{5}{8}$

EXAMPLE 2.

What principal will gain £40 in 8 months at 5 *per Cent per* annum?

First by *Reduction* 8 months = $\frac{8}{12}$ = $\frac{2}{3}$ of a year

Then as * $\frac{5}{1}$ ——— $\frac{100}{1}$ ——— $\frac{40}{1}$

$\frac{2}{3}$ ————————— $\frac{3}{2}$ *

$$\begin{array}{rr} 100 & 5 \\ 40 & 2 \\ \hline 4000 & 10\ D. \\ 3 & \\ \hline 12000\ N. & \end{array}$$

Answ. $\frac{12000}{10}$ = £1200

Or by two statings thus,

* $\frac{5}{1}$: $\frac{100}{1}$ :: $\frac{40}{1}$

$$\begin{array}{r} 100 \\ 40 \\ \hline 5)\ 4000 \\ \hline £\ 800 \end{array}$$

* $\frac{1}{1}$: $\frac{800}{1}$ :: $\frac{2}{3}$ *

$\frac{2}{3}$) $\frac{800}{1}$ ($\frac{2400}{2}$ = £1200 as before.

Note. This last stating is in *Reciprocal Proportion.*

EXAM-

EXAMPLE 3.

If 12 men ſpend £20 in 9 months, how much will ſerve 16 men 18 months?

Firſt by *Reduction* 9 months $= \frac{9}{12} = \frac{3}{4}$ of a year, and 18 months $= 1\frac{1}{2}$ year $= \frac{3}{2}$. *Then*

men

As * $\frac{12}{1}$ —— $\frac{20}{1}$ —— $\frac{16}{1}$

* $\frac{3}{4}$ —————— $\frac{3}{2}$

20	2
16	12
320	24
3	3
960	72 *D.*
4	
3840 *N.*	

Anſwer $\frac{3840}{72} = \frac{160}{3}$
£53 6s 8d

S C H O L I U M.

Having ſo copiouſly elucidated every difficulty that can poſſibly occur in *Vulgar Fractions*, I ſhall now preſent my readers with two *uſeful and curious articles* therein, ſent me by the *truly ingenious* Mr. *Nathaniel Brownell* teacher of the Mathematics in *Coventry Warwicſhire*.

Curious Articles in VULGAR FRACTIONS.

ARTICLE I.

TO expreſs the proportion *that any* one, two, three *or* more fractions *have one to* another *in whole numbers*.

1. If it be required to know, what proportion the numerator bears to the denominator of any fraction, if it be a compound one, you muſt reduce it to a ſingle one, and then reduce it to its loweſt terms, and the numbers expreſſing the fraction ſo reduced, will be

be the numbers ſought. But if the fraction given be a ſingle one, whether proper or improper, you have nothing to do but reduce it to its loweſt terms, and the new fraction is the anſwer ſought. So if the queſtion was made by a mixt number, firſt reduce it to an improper fraction, in its loweſt terms, and the numerator and denominator ſo reduced is the anſwer.

2. If the given fractions have a common denominator, then the numerators are the whole numbers that expreſs the proportion, and if they can be reduced lower, you may do it as in the following example.

Example 1.

What are the whole numbers that expreſs the proportion of $\frac{3}{7}$ to $\frac{6}{7}$?

Here rejecting the common denominator, the anſwer will be 3 and 6, *i. e.* the two given fractions will have the ſame proportion to one another, as the whole numbers 3 and 6 have to one another, and as 3 and 6 may be divided by 3, the quotients 1 and 2, will ſhew the proportion to be as 1 is to 2.

3. If the given fractions have not a common denominator, then reduce them to fractions that have a common denominator, and work as above.

Example 2.

What proportion have $\frac{2}{3}$ to $\frac{1}{5}$?

The fractions when reduced to a common denominator will be $\frac{10}{15}$, and $\frac{3}{15}$, ſo that their proportion is as 10 to 3, which are numbers prime to one another, becauſe they cannot be reduced any lower, or have no other common diviſor but unity.

Example 3.

What proportion is between $\frac{2}{3}$ of $\frac{5}{6}$ of $\frac{9}{13}$?

Anſwer. The numerator is to the denominator, as 5 to 13, for having reduced the compound fraction to

to a simple one, it comes to $\frac{90}{234}$; which reduced to its lowest terms becomes $\frac{5}{13}$, so that the whole numbers 5 and 13, are the whole numbers that express their true proportion in the lowest terms.

EXAMPLE 4.

Express the proportion of $\frac{8}{18}$ in its lowest terms, in whole numbers.

$\frac{8}{18}$ abbreviated becomes $\frac{4}{9}$; so that the fraction is as 4 to 9.

EXAMPLE 5.

What's the proportion of $\frac{7}{9}$ in whole numbers?

This being a fraction whose numerator is prime to its denominator, the answer in whole numbers is as 7 to 9.

EXAMPLE 6.

Express in whole numbers the proportion of $\frac{225}{675}$ to $\frac{26}{72}$.—The fractions in their lowest terms become $\frac{1}{3}$ and $\frac{13}{16}$ which being reduced to a common denominator, are $\frac{16}{48}$ and $\frac{39}{48}$.

Now rejecting, or throwing away the common denominator, the numerators not admitting of a common divisor, or of being reduced any lower, the said numerators are the numbers sought, *viz.* the given fractions are in proportion to one another as 16 to 39.—After the same manner you may proceed with 3, 4, 5, or any other number of given fractions.

ARTICLE 2.

It will be convenient and useful in fractions *to know*

1. That if the difference between the numerator and denominator be an unit, and the fraction be either proper or improper, you need not to multiply by the numerator at all, but only divide by the denominator; and if the denominator be less than the numerator, add, or otherwise subtract that quotient to, or from the given number, and the sum or difence will be the answer.

2. Or

2. Or if the difference between the numerator and denominator be more than an unit, multiply the given number by the said difference, divide that product by the denominator, and add or ſubtract the quotient to or from the given number, according as the denominator is bigger or leſſer than the numerator, and the ſum or difference is the anſwer.

3. From theſe two obſervations it is very evident that, if the diviſor *i. e.* the denominator be broken into two parts, as directed in ſhort diviſion, and the aforeſaid difference be either an unit bigger, or leſs than one of thoſe parts, you need not to multiply by the ſaid differenee, but only divide firſt by that part which differeth from the ſaid difference by an unit, and according as the ſaid difference is an unit more, or leſs than the ſaid part you muſt add or ſubtract, that quotient to, or from the given number, then you muſt divide that ſum or remainder by the other part of the denominator, and if the denominator be leſs than the numerator, add, or otherwiſe ſubtract that laſt quotient to, or from the given number, and the ſum, or remainder will be the anſwer.

4. Or if the difference of the numerator and denominator be an aliquot part of the denominator, there will be no occaſion either to multiply by the ſaid difference, or divide by the denominator, but only divide the given number by the denominator of ſuch aliquot part, and ſo add, or ſubtract that quotient to, or from the given number, and the ſum or remainder is the anſwer.

What is the $\frac{4}{5}$ parts of a Ship's cargo worth, the whole being valued at £2713 12*s.* 8*d.*?

	£.	*s.*	*d.*
5)	2713	12	8
Subtract	542	14	6 $\frac{1}{4}$ $\frac{3}{5}$
Anſwer	2170	18	1 $\frac{1}{2}$ $\frac{2}{5}$

EXAMPLE *to Observation the Second.*

What's the value of $\frac{27}{32}$ parts of an estate whose value is £364 16*s.* 8*d.*?

		£.	s.	d.
		364	16	8
				5
32	4)	1824	3	4
	8)	456	–	10
Subtract		57	–	1 $\frac{1}{4}$
Answ.		307	16	6 $\frac{3}{4}$

Here the difference between the numerator and denominator is 5, therefore I multiply by 5, and divide the product by the denominator 32, and because the numerator is less than the denominator, subtract the quotient from the multiplicand, and the remainder is the answer.

Or without Multiplication by the 3d. Observation.

		£.	s.	d.
	4)	364	16	8
Add		91	4	2
	8)	456	–	10
Subtract		57	–	1 $\frac{1}{4}$
Answ.		307	16	6 $\frac{3}{4}$

Here because 5, which I should multiply by, is one unit more than 4, one of the aliquot parts of 32, I divide by 4, and add, then I divide the sum by 8 and subtract.

EXAMPLES *to Observation the Fourth.*

What is the $\frac{105}{112}$ part of £51 12*s* 8*d*?

		£.	s.	d.
	4)	51	12	8
	4)	12	18	2
Subtract		3	4	6 $\frac{1}{2}$
Answ.		48	8	1 $\frac{1}{2}$

In this example the difference between the numerator and denominator is 7, which is an aliquot part of the denominator, *viz.* $\frac{1}{16}$th, therefore I divide by 16, and subtract the quotient from the given number, because the denominator is bigger than the numerator, and the remainder is the answer.

More EXAMPLES *for Exercise to the preceding Observations.*

1. Suppose *A* and *B* buy a parcel of yarn, which cost £486 16*s.* 4*d.* *A* to pay $\frac{5}{8}$ of the price, and *B* $\frac{3}{8}$ of the price, how much must each pay?
Answer *A* £304 5*s.* 2*d.* $\frac{1}{2}$, and *B* £182 11*s.* 1*d.* $\frac{1}{2}$.

2. *A* and *B* bought 74 *C.* 1 *qr* 15 *lb.* of cotton wool, which cost £376 4*s.* 9*d.* *A* to have $\frac{7}{12}$, and *B* $\frac{5}{12}$, how much wool must each man have, and what must each pay?

			C.	*qr.*	*lb.*
Answer	*A.*	must have	43	1	15 $\frac{3}{4}$
	B.		30	3	27 $\frac{1}{4}$

	£.	*s.*	*d.*
And must pay	219	9	5 $\frac{1}{4}$
	156	15	3 $\frac{3}{4}$

3. Three merchants *A. B. C.* purchased a Ship and cargo, which cost £586 12*s.* 8*d.* *A.* was to pay $\frac{2}{5}$ *B.* to pay $\frac{3}{8}$, and *C.* the rest, what must each pay?
Answ. *A.* £234 13*s.* –*d.* $\frac{3}{4}$ $\frac{1}{5}$, *B.* £219 19*s.* 9*d.* and *C.* £131 19*s.* 10*d.* – $\frac{4}{5}$.

PROMISCUOUS QUESTIONS.

Question 1. By Mr. *Thomas Dilworth.*

Says *Jack* to his brother *Harry*, I can place *four threes* in such a manner, that they shall make just 34; can you do so?

Solution.

$$\begin{array}{r} 33 \\ \frac{3}{3} = 1 \\ \hline 34 \end{array}$$

Answer 33 $\frac{3}{3}$

 Question

Question 2. From Mr. *Birks's* Arithmetic.

If the Scavenger's rate at 1*d*. $\frac{1}{2}$ in the pound, comes to 6*s*. 7*d*. $\frac{1}{2}$ where they ordinarily assess $\frac{4}{5}$ of the rent; what will the *King's* tax for that house be, at 4*s*. the pound, rated at the full rent?

First by *Reduction* of *Vulgar Fractions* $1d\frac{1}{2} = £\frac{1}{160}$, $6s\ 7d\frac{1}{2} = \frac{159}{480} = \frac{53}{160}£$, and $4s = \frac{1}{5}£$.

Then say 1st, As * $\overset{£.}{\frac{1}{160}} : \overset{£.}{\frac{1}{1}} :: \overset{£.}{\frac{53}{160}}$

$$\tfrac{1}{160})\ \tfrac{53}{160}\ (\tfrac{8480}{160} = \begin{array}{r} 4)\ £ \\ 53 \\ 13\frac{1}{4} \end{array} \left.\right\} = \left\{ \begin{array}{c} \frac{4}{5} \\ \frac{1}{5} \end{array} \right\} \text{ of the rent}$$

$£66\frac{1}{4}$ whole rent

2*d*. A* $\frac{1}{1} : \frac{1}{5} :: 66\frac{1}{4} = \frac{265}{4}$

$$\begin{array}{ll} 1 & 5 \\ 265 & 4 \\ \hline 265\ N. & 20\ D. \end{array}$$

Answ. $\frac{265}{20} = \frac{53}{4} = £13\ 5s.$

Question 3. By Mr. *Randles*, *Ladies Diary* 1752.

A gentleman has an Orchard of fruit trees, $\frac{1}{2}$ of the trees bearing apples, $\frac{1}{4}$ pears, $\frac{1}{6}$ plums, and 50 of them bearing cherries, how many fruit trees in all grow in the said Orchard?

The fractions in this question *viz*. $\frac{1}{2}$, $\frac{1}{4}$ and $\frac{1}{6}$, reduced to a common denominator (by the *note* to *case* 9 *page* 251) make $\frac{6}{12}$, $\frac{3}{12}$, and $\frac{2}{12}$, whereby the whole number of trees is divided into 12 equal parts, whereof those that bear apples are 6, pears 3, and plums 2, which added together make $\frac{11}{12}$, so that $\frac{11}{12}$ being all the trees except the cherries, it is evident (*the whole being divided into* 12 *parts*) that they must be the remaining $\frac{1}{12}$, which by the question is equal to 50, then $\frac{12}{12}$ or the whole must be 12 times 50 = 600 the number

number of trees in the Orchard, and of which $\frac{6}{12}$ or $\frac{1}{2}$ bear apples $= 300$, $\frac{3}{12}$ or $\frac{1}{4}$ pears $= 150$ and $\frac{2}{12}$ or $\frac{1}{6}$ plums $= 100$ so that the number of each sort will be as under *viz.*

Of those that bear	Apples	300
	Pears	150
	Plums	100
	Cherries	50
Total number		600 as in the preceding *page*.

Question 4. By Sir *Isaac Newton.* See his Universal Arithmetic.

Three workmen can do a piece of work in certain times, *viz.* *A* can do it in 3 weeks, *B* can do thrice the work in 8 weeks, and *C* five times in 12 weeks; in what time can they finish it jointly?

It is evident by the question (or may *very easily* be found by the *Rule of Three*) that *A* can do $\frac{1}{3}$, *B* $\frac{3}{8}$ and *C* $\frac{5}{12}$ of the work in *one week*, which fractions being reduced to a common denominator (see the *note* to *case* 9 *page* 251) make $\frac{8}{24}$, $\frac{9}{24}$ and $\frac{10}{24}$ whose sum is $\frac{27}{24} = \frac{9}{8}$ being the work that they can do when all are working together *one week*, Then

$$\begin{array}{lccccc} & \text{work} & & \text{days} & & \text{work} \\ \text{If} & \frac{9}{8} & : & \frac{6}{1} & :: & \frac{1}{1} \end{array}$$

$$\tfrac{9}{8})\ \tfrac{6}{1}\ (\tfrac{48}{9} = \tfrac{16}{3} = 5\tfrac{1}{3} \text{ days answer}$$

The following question was sent me (with some others,) by the ingenious Mr. *Isaac Gumley* of *Countesthorpe* near *Leicester*, and as it seems to be a pretty piece of entertainment for my fair readers, shall give it a place in this book.

Question 5. By Mr. *Isaac Gumley*.

Says *John* a homely country *swain*,
To *Nan* the glory of the plain,
On whom he'd fix'd his love;
Dear *Nancy* name the happy day,
When thou wilt give thyself away,
And all my doubts remove.

2.

O say when thou at Church wilt stand,
And give to me thy lovely hand,
And make me truly blest;
My charming maid, O! let me know,
When my fond heart with joy shall glow,
Which finds but little rest.

3.

Dear *John* says she I love you well,
And think you all the swains excel,
In beauty and good sense;
Then answer me this question pray;
And thou wilt find the happy day,
When I'll the boon dispense.

4.

One sixth, one fourth, * when join'd to *four*,
Will give the day, less *half a score*,
The day o'th' month I mean;
So now prepare the gloves and ring,
And be as happy as a king,
And I will be your queen.

5

But *John* has try'd and try'd again,
Until he's almost crack'd his brain,
Yet cannot find it out;
Then help him O ye *swains* of art,
To find the day and ease his heart,
And banish ev'ry doubt

* $\frac{1}{6}$, $\frac{1}{4}$ of the day of the month.

Solution

Solution.

First the fractions $\frac{1}{6}$ and $\frac{1}{4}$ added together make $\frac{5}{12}$, *Then* (it is evident by the question that) $\frac{5}{12} + 14 = \frac{12}{12}$ or the whole.—Now the following being a self evident Axiom *viz. if from equal things an equal quantity be taken away, the remainders will be equal to each other*, therefore by subtracting $\frac{5}{12}$ from each side of the above equation, it will be $\frac{7}{12} = 14$, Then as $7 : 14 :: 12 : 24$ the answer.

On the *twenty-fourth* day young *Johnny* will find,
The delights of a *Fair*, who is virtuous and kind.

DECIMAL FRACTIONS.

JOHN Muller * as some authors † say,
Invented first this curious way,

Of

---

* Otherwise called *Regiomontanus*.

† *Malcolm*, *Potter* &c. But Mr. *Ward* seems at an uncertainty who was the first Inventor.

Mr. *Malcolm* in his history of Arithmetic *page* 18, says that "*Regiomontanus* about the year 1464, is "the first we know who in his *Triangular Tables* di-"vided the Radius into 10,000 parts instead of "60,000; and so tacitly introduced Decimal parts "in place of *Sexagesimals*, *Ramus* in his arithmetic "written about 1550, (and published by *Lazarus* "*Schonerus* in 1586) uses Decimal periods in car-

 "rying

Of working ſums by equal parts,
To ſhine conſpicuous in the arts;
By *Decimals* all Fractions are,
With freedom wrought and made out clear.
By eaſy rules juſt to your mind,
Heights, depths, and diſtances you find,
You traverſe by their well known aid,
To things ſublime—by learning made
To ſoar above, where planets roll,
And meaſure true from pole to pole,
Then *Tyro* haſte, judicious be,
And ſoon their excellence you'll ſee.

Notation of Decimals.

By *Decimals* you are to underſtand, that the Integer or unit (be what it will) is ſuppoſed to be divided into 10 equal parts, and every one of thoſe parts into 10 other equal parts, and ſo on by a continual ſubdiviſion, and are ſeparated diſtinguiſhed or known from Integers, by a point or dot placed to the left hand of the fractional parts or numbers, (be what they will) without their denominators, for as dividing a number by 10, 100, 1000 &c. is only ſeparating ſo many of the right-hand figures from the reſt, as there are ciphers in the diviſor (ſee *page* 116) therefore decimal denominators need not be wrote, as eaſily underſtood to be *unity* with as many ciphers annexed as are equal to the number of figures, ſeparated or pointed off to the right-hand.

" rying on the extraction of Square and Cube Roots
" to Fractions. The ſame did our Country-man
" *Bucklaus* before *Ramus*; and *Record* about the
" ſame time. But the firſt who wrote an expreſs
" treatiſe of Decimals, was *Simon Stevinus*, about
" 1582."

Thus

The Fraction		is wrote without its denominator		and signifies	
	$\frac{74}{10}$		7.4		7 units & 4 tenth parts of an unit.
	$\frac{6754}{100}$		67.54		67 units & 54 hundreth parts of an unit.
	$\frac{8514}{1000}$		8.514		8 units & 514 thousandth parts of an unit.
	$\frac{6}{10}$		.6		6 tenth parts of an unit.
	$\frac{6}{100}$		.06		6 hundredth parts of an unit.
	$\frac{6}{1000}$		.006		6 thousandth parts of an unit.

So that

It is obvious that if a numerator does not consist of as many figure as there are ciphers in its decimal denominator, the defect must be supplied by prefixing a cipher or ciphers to (the left hand of) the numerator, and that every cipher so placed or prefixt, makes the decimal to signify but a tenth part of what it did.

for .006 and .06 is but one tenth part of .06 .6 But ciphers annexed to the numerator of a decimal, also supposes a like number to be annexed to the denominator, and therefore multiplies both by the same number, which does not alter the value of the fraction,

Thus

$$\text{Thus}\left\{\begin{array}{l}.8\\ .80\\ .800\end{array}\right\}\text{signifies}\left\{\begin{array}{c}\frac{8}{10}\\ \frac{80}{100}\\ \frac{800}{1000}\end{array}\right\}=\tfrac{4}{5}$$

Hence it is manifest that ciphers placed to the right hand of a decimal, neither augment nor diminish its value, and therefore may be annexed to, or rejected from, the right hand of decimals at pleasure.

ADDITION IN DECIMALS.

RULE.

AS in whole numbers write directly,
Your figures down most circumspectly,
The units under units place,
And point them off with reg'lar grace,
Then add them up as taught before,
And you'll the sum with ease explore.

Exam. 1.	Exam. 2	Exam. 3.	Exam. 4.
1.46	5.4167	861.4	567
27.678	.9001	56.59	14.1419
.416	71.006	3.1	.8167
514.3	4.12	51.691	5.4
An. 543.854	81.4428	972.781	587.3586

Exam. 5.

.4167
.0141
.9815
.3017

An. 1.714

Example 6.

$$\begin{array}{l}\text{To}\\ \text{Add}\left\{\begin{array}{c}79\\ 8\\ 57\end{array}\right\}\text{of}\left\{\begin{array}{l}\text{a hun.}\\ \text{a tho.}\\ \text{10 tho.}\end{array}\right\}\end{array}\begin{array}{l}15.9463\\ \\ \\ \\ \end{array}=\left\{\begin{array}{r}15.9463\\ .79\\ .008\\ .0057\end{array}\right.$$

Answer 16.75

SUBTRACTION

SUBTRACTION IN DECIMALS.

RULE.

AS in whole numbers you proceed—
To point as taught before take heed
A leſſer from a greater take,
And you'll the diff'rence quickly make.

	EXAM. 1.	EXAM. 2.	EXAM. 3.	EXAM. 4.
From	.8141	1.4165	734 15	14.
Take	.7691	.346	641.739	.9146
Rem.	.045	1.0705	92 411	13.0854
Proof	.8141	1.4165	734.15	14.

MULTIPLICATION IN DECIMALS.

RULE.

AS in whole numbers multiply
Your factors true continually,
Point off what decimals there be,
In both the factors, then you'll ſee,
Your product wrought compleat and fair,
As quickly will be made t' appear.

Note. If there be not ſo many figures in the product as there are decimals in the factors, a cipher or ciphers muſt be prefixt to ſupply the defect.

EXAM-

EXAMPLE 1.		EXAMPLE 2.	
Multiply	141.14	Multiply	7.4587
By	5.46	By	.00876
	84684		447522
	56456		522109
	70570		596696
Product	770.6244	Product	.065338212

In example 2 there are 9 places of decimals in the factors, and but 8 figures in the product, therefore a cipher is prefixt to supply the defect.

EXAMPLE 3.
Multiply 54.567
By 10

Product 544.67 †

† *Hence* it is plain that *to multiply any decimal fraction or mixt number by an unit with any number of ciphers annexed*, is only removing the decimal point so many places farther to the *right hand*, as there are ciphers in the multiplying factor and subjoining ciphers if need be. So if 78.54 were to be multiplied

By		the prod. will be	
	10		785.4
	100		7854.
	1000		78540.
	10000		785400.

Multiply	75.4678
By	6.05408
	60|37424
	3018|7120
	37733|90
	4528068|0
Prod.	456.8880|98624*

* In this product you see there are 9 places of decimals, but as in most cases 3 or 4 are sufficient, it is therefore very necessary to become acquainted with the following most useful CON-

CONTRACTION

To multiply any given factors, and have in the product any desired number of Decimal parts less than the whole of such parts.

R U L E.

Under the multiplicand place the multiplier in an inverted order, so that its unit figure (before inverted) may stand under that place of parts in the multiplicand, as you would have the last figure of the product to be, then in multiplying reject all the figures in the multiplicand which are on the right of the figure you are multiplying by, placing the products so, that their right hand figures may fall straight below each other, and carry to such right hand figures from the product of the 2 next rejected multiplicand figures thus, *viz.* 1 from 5 to 15, 2 from 15 to 25, 3 from 25 to 35, &c. and the sum of the lines will be the product to the number of decimal places required, and will be seldom wrong in the last figure.

EXAMPLE 1.

Multiply 75.4678 by 6.05408 so as to retain only 4 places of decimals in the product (see this example worked at large in the preceding *page*)

Multiplicand	75.4678
Mult. inverted	80450.6
	4528068
	37734
	3019
	60
Product	456 8881

EXAMPLE 2.

Multiply 6.485676
By 4587.0 so as to retain 3 places of decimals

Multiplicand	6.485676
Mult. inver.	4587.0
	4540
	519
	32
	2
Product	5.093

EXAMPLE 7.

Multiply .68479
By .0765 to have 5 places of decimals in the product.

	.68476
	5670.0
	4793
	411
	34
Product	05238

Note. As *this contraction* and *that* which follows in division are quite practical and facile, and answer the same end as the method of *Recurrents* or *Circulating Decimals* doth, therefore to have treated on them wou'd certainly have been swelling this treatise to no manner of purpose but curiosity only. See *page* 193 of *Birks's* arithmetic, where that author says, they are more curious than useful.

DIVISION IN DECIMALS.

RULE.

AS in whole numbers you divide,
Observe this useful hint beside,
What decimals your dividend,
Exceeds th' divisor, then my friend,
Cut from the quote that number true,
The decimal appears to you,
As the annext examples shew.

Note. If the quotient does not contain a sufficient number of figures to be pointed off, the defect must be supplied by prefixing cyphers thereto.

EXAMPLE

EXAMPLE 1.

Divide 55.37376 by 4.176.

```
4.176) 55.37376 (13.26
       41 76
       ------
       13 613
       12 528
       ------
        10 857
         8 352
        ------
         2 5056
         2 5056
         ------
              0
```

In this example the number of decimal places in the dividend, exceeds those in the divisor by 2, therefore that number of decimals is pointed off in the quotient.

EXAMPLE 2.

Divide 4.68 by 123.45.

```
123.45) 4.6800 (.03791
        3 7035
        ------
         97650
         86415
         ------
         112350
         111105
         ------
          12450
          12345
          -----
            105
```

When any dividend contains fewer figures than its divisor, a competent number of ciphers must be annexed after the decimal point in the dividend, to make it contain the divisor some number of times less than 10, and as you proceed a cipher must be subjoined to each remainder, till the dividend is continued to a sufficient number of decimal places.—In this example the dividend is continued to 7 places of decimals, which being 5 more than those in the divisor, therefore a cipher is prefixt to the quotient as not otherwise containing figures enow to be pointed off, to make it consist of that number of decimals.

EXAMPLE 3.

Divide .078246 by .042

```
.042) .078246 (1.863
       42
       ---
       362
       336
       ---
        264
        252
        ---
         126
         126
         ---
           0
```

EXAMPLE 4.

Divide .45674 by 82.

```
82) .45674 (.00557
     410
     ---
      467
      410
      ---
       574
       574
       ---
         0
```

In this example there being 5 places of decimals in the dividend, and none in the divisor, therefore 2 ciphers are prefixt to the quotient to make it consist of its proper number of decimal places.

EXAMPLE 5.

Divide .75£ by .0125.£

```
.0125) .7500 (60£
        750
        ---
         .0
```

In this example the number of decimal places in the dividend being (by annexing 2 ciphers) made equal in number to the decimals in the divisor, therefore 60 the quotient is a whole number.—This example is the same as if it were required to divide 15*s* by 3*d*, a pound being the Integer, for the decimal

mal of 15*s* is 75£ and that of 3*d*, .0125£ as will be easily known when you understand *Reduction of Decimals*. Hence it is manifest that

As *Multiplication* / So *Division*	of fractions	*decreaseth* their value / *increaseth* it, contrary

in both to the nature of Integers.

EXAMPLE 6.

Divide 987.65 by 100.

100) 987.65

9.8765 Quotient, whereby it is plain that *to divide any decimal fraction or mixt number by an unit with a cipher or ciphers annexed*, is only removing the decimal point in the dividend so many places farther to the *left hand* as there are ciphers in the divisor, prefixing ciphers to the dividend if need be.

Thus

$$88.62 \text{ divided by} \left\{ \begin{array}{r} 10 \\ 100 \\ 1000 \\ 10000 \end{array} \right\} \text{quotes} \left\{ \begin{array}{l} 8.862 \\ .8862 \\ .08862 \\ .008862 \end{array} \right.$$

From what has herein before been said relating to Division it may be easily observed that the first figure of every quotient (as well in Division of Integers as Decimals) must possess the same place (with respect to its value) as that figure of the dividend doth, which stands over the unit's place of the first figure's product and which is an eligible RULE *to value quotients* obtained by the following useful

CONTRACTION

When the divisor consists of many figures the division at large will be troublesome, but may be much abbreviated by the following

 RULE

RULE.

Reject as many of the right hand figures in the divisor as will make it consist of the same number of figures there is to be in the quotient, observing to carry from such rejected figures as directed in the contraction of Multiplication *page* 287 and instead of taking down a figure from the dividend to each remainder, point off a figure each time from the right hand side of the divisor till it be exhausted, but if the divisor does not consist of as many figures as there are to be in the quotient, work with the whole divisor the usual or common way till the defect is supplied, and then proceed as above directed.

EXAMPLE I.

Divide 423.68946 by 59.6874:

Contracted Method

```
59.687|4) 423.68946 (7.0984
 . . . .  417812
          ------
            5877
            5372
            ----
             505
             477
             ---
              28
              24
              --
               4
              --
```

In this example one figure is cut off from the divisor, because it contains 1 more than was to be found, and as 3 the units place of the dividend, stands over 7 the units place of the first figure's product, therefore the first figure in the quoient is units.

Common Method.

```
59.6874) 423.68946 (7.0984
         41781118
         --------
            5877|660
            5371|866
            --------
             505|7940
             477|4992
             --------
              28|29480
              23|87896
              --------
              24|41584
              --------
```

EXAMPLE

EXAMPLE 2.

Divide 69.7482 by 84.5 so that the quotient may contain 4 decimals.

84.5) 69,7482 (.8254
67 60
———
21 48
16 90
———
45 8
42 3
———
3 5
3 4
—
1
—

EXAMPLE 3.

Divide .045768 by .9874

0.9874) .045768 (.04635
39496
———
6272
5924
———
348
296
———
52
49
—
3
—

In the second example one figure is taken down from the dividend, because the divisor contains one figure less than what is required to be in the quotient, and as 7 the *first place of Decimals* in the dividend, stands over 6 the units place of the first figure's product, therefore 8 the first figure in the quotient is in the *first place of Decimals*.—And in the 3d example the *second place of Decimals* in the dividend *viz.* the figure 4 stands over 3 the units place of the first figure's product, therefore a cipher is prefixt to the figure 4 in the quotient, to make it possess the *second place* also.

REDUCTION IN DECIMALS.

CASE 1.

To reduce any Vulgar Fraction *to an equivalent* Decimal *one.*

RULE.

FIRST to the numerator add
Cyphers at pleasure,—then is had
Your decimal,—if you divide
By th' denominator true beside.

EXAMPLE 1.

One third of a unit discover to me,
In decimal parts and with truth to agree.

3) 1.0000

.3333 &c. *ad infinitum.*

EXAMPLE 2.

Reduce $\frac{13}{145}$ to a Decimal.

145) 13.00 (.089
1160
1400
1305
950
870
80

EXAMPLE 3.

Reduce $\frac{1}{2}$ of $\frac{3}{5}$ of $\frac{5}{8}$ to a Decimal.

First the compound fraction $\frac{1}{2}$ of $\frac{3}{5}$ of $\frac{5}{8}$ reduced to a simple one becomes $\frac{15}{80}$

Then

8|0) 15.0000

.1875

Note. It frequently happens that Decimals will not terminate, but that there will still be a remainder (as in this example) but if the decimal be continued to 4 or 5 places, it will be exact enough in most cases, and the remainder may be safely rejected as being so very inconsiderable.

EXAMPLE

EXAMPLE 4.

Reduce me this fraction * to decimal parts *$\frac{5}{16}$
And you shall arrive to be master of arts.

$$16\begin{cases}2)\ \underline{5.0}\\ 8)\ \underline{2.5}\end{cases}$$

Answer .3125

CASE 2.

To reduce the parts of money, weights, measure &c. *to a* Decimal.

RULE 1.

Reduce the parts to the lowest denomination given and express them as a vulgar fraction making the Integer (when reduced to the same name) the denominator. But *Note* if the given number be a simple one it needs no preparation, for it will be the numerator, and the Integer (in the same name) the denominator, with which vulgar fraction proceed as directed in the preceding *page*.

RULE 2.

Place the numbers of the several denominations under each other beginning with the least, and divide each by such a number that will raise it to the next superior name (as directed in *Reduction of Integers*) placing each quotient as a Decimal part of the next dividend before it be divided, and the final quotient will be the answer.

EXAMPLE 1.

Reduce 18*s* 6*d* $\frac{3}{4}$ to the decimal of a pound Sterling.

SOLUTION

SOLUTION *by*

Rule 1.

First 18*s* 6*d* $\frac{3}{4}$ = 891 *qrs*
Then 891 *qrs* = $\frac{891}{960}$ of a £ which fraction reduced by *Case* 1 *page* 294, makes .928125 £ the decimal required.

Rule 2.

$$\begin{array}{r|l} 4 & 3.0 \\ 12 & 6.75 \\ 2|0 & 18.5625 \\ \hline \text{An.£} & .928125 \\ \hline \end{array}$$

By this method, first the 3 farthings are reduced to the decimal of a penny, then the 6.75 pence to the decimal of a shilling, and lastly the 18.5625 shillings to the decimal of a pound.

EXAMPLE 2.

Reduce 15*s* to the decimal of a pound.

First 15 = $\frac{15}{20}$ of a £.
Then (*by Case* 1 *page* 294)

$$\begin{array}{r} 2|0)\ 15.0 \\ \hline \end{array}$$

Answ. £.75

EXAMPLE 3.

Reduce £4 15*s* 7*d* $\frac{1}{2}$ to the denomination of pounds.

$$\begin{array}{r|l} 2 & 1.0 \\ 12 & 7.5 \\ 2|0 & 15.625 \\ \hline \end{array}$$

Ans. £4.78125

EXAMPLE 4.

Reduce 18*s* 6*d* to the decimal of a pound.

$$\begin{array}{r|l} 12 & 6.0 \\ 2|0 & 18.5 \\ \hline \end{array}$$

Answ. £.925

EXAMPLE 5.

What decimal part of a pound tell me true
Is six-pence.—This *Tyro* you'll presently do,
And shine with *Minerva*, in her fine retreat,
Where *Newtons*, *Boyles*, *Hallys* and *Emersons* wait.

First

First 6*d* = $\frac{6}{240}$ of a £.

Then (*by Case* 1 *page* 294)

```
240) 6.00 (.025 Answ.
     480
     ----
     1200
     1200
     ----
        .
```

Or agreeable to *Rule* the 2d, thus

```
12|6.0
2|0|0.5
   -----
   £.025
```

Example 6.

Reduce 36 poles to the decimal of an acre.

```
40|36.0
 4| 0.9
   -----
Answ.  .225
```

Example 8.

Reduce 15 dwt. 12 grs. to the decimal of an ounce Troy.

```
24 { 3|12
   { 8| 4.0
  2|0|15.5
     -----
Answ.  .775
```

Example 7.

Reduce 4*C.* 3*qrs.* 8*lb.* to the decimal of a tun.

```
28 { 4|8.
   { 7|2.0
     4|3.285714+
   2|0|4.821428+
       ----------
Answ.  .2410714+
```

Example 9.

Reduce 3 inches to the decimal of a yard.

```
12|3.0
 3|0.25
   -----
Answ.  .0833 &c.
```

These examples being well understood are sufficient to shew how to reduce any parts of other weights, measures, &c. into decimals, therefore shall now proceed to

CASE

CASE 3.

To find the value *of any* Decimal Fraction *in the known parts of the Integer.*

RULE

Multiply the given decimal by the known parts of the next inferior denomination, and point off in the product as many places of decimals as there are in the given decimal fraction, then reduce the decimal produced, to the next inferior name, pointing off the product as before, and so proceed to the least known denomination or as far as necessary, and the figures on the left hand the dots or points will be the value required.

Example 1.

I'th' parts in the margin * come *Tyro* unfold, * 26875
The value, be't copper, be't silver or gold. parts of a £

£.
.26875
20
s ———
5 375
12
d ———
4.5
4
———
½. 0
———
Answ. 5*s* 4*d* ½

Example 2.

What is the value of .845 Cwt.?

.845
4
———
qrs. 3.38
28
———
304
76
———
lb. 10.64
———

Example 3.

What is the value of .928125 £?

20
s ———
18.5625
12
d ———
6.75
4
———
¾.0
———

Example 4.

Now *Tyro* advance learn the *Decimal* art,
In ſurveying eſtates you'll then ſoon take a part,
Come tell me the parts in the margin * ſubjoin'd, *.8375
Of an acre of land roods and poles, both combin'd,
Come do this thing clearly, no doubt very ſoon,
You'll be a Surveyor, and meaſure the moon.

$$\begin{array}{r} .8375 \\ 4 \\ \hline 3.35 \\ 40 \\ \hline 14.0 \\ \hline \end{array}$$

An. 3 rds. 14 pls.

Example 5.

What is the value of .8146 hhd.

$$\begin{array}{r} 63 \\ \hline 24438 \\ 48876 \\ \hline 51.3198 \\ \hline \end{array}$$

A. 51.3198 gal.

Example 6.

What is the value of .775 oz. Troy.

$$\begin{array}{r} .775 \\ 20 \\ \hline 15.5 \\ 24 \\ \hline 12\ 0 \\ \hline \end{array}$$

A. 15dwt. 12grs.

Case 4.

To find the value *of any* Decimal *by* inſpection, *a pound Sterling being the Integer.*

RULE.

Double the figure in the firſt place of the given decimal (*viz.* that figure next to the units) for ſhillings, and if the figure in the 2d place be 5 or more, then add 1 to the double of the firſt figure, and the 2d figure if under 5 or the exceſs if above 5 prefix to the 3d figure and reckon 'em as farthings, abating 1 when they are above 25 and 2 when above 40.

Example

EXAMPLE 1.

What is the value of .26875£ ?

The first figure doubled with 1 added (because the 2d figure is more than 5) is 5*s*. then 1 (the second figure's excess above 5) prefixt to 8 the third figure makes 18 farthings, *viz*. 4*d* ½ so that the value is 5*s* 4*d* ½ the same as in *page* 298.

EXAMPLE 2.

What is the value of .928125£ ?

The 9 doubled is 18*s*, and the 2 next figures *viz*. 28, abating 1 (as they are more than 25) make 6*d* ¾ therefore the value is 18*s* 6*d* ¾ the same as in *page* 298.

EXAMPLE 3.

What is the value of 846£ ?–The 8 doubled is 16*s*, and 46 farthings abating 2 are 11*d*, therefore the value is 16*s* 11*d*

Amusing Questions.

Question 1.

In the 2d book of *Samuel* Chap. 14. we read that *Absalom* cut off the hair of his head every year, and that it weighed 200 half ounce Shekels. What was the weight in pounds and decimal parts of a pound.

First 200 Shekels or half ounces = 100 ounces

Then

$$16\begin{cases} 2)\,100 \\ \overline{} \\ 8)\ \ 50 \end{cases}$$

Answer 6.25 = 6*lb*. ¼

Question

Question 2.

Goliah's great gigantic ſize,
Six cubits * and a ſpan, †
He led his hoſt with glaring eyes,
Cry'ng chuſe me out the man,
Who dares in ſingle combat fight
Me,—let him try his ſkill,
For I defy each *Iſr'elite*,
His ſtrength be what it will.
With glitt'ring helmet on his head,
Well arm'd with *Coat of Mail*,
Which juſt five thouſand Shekels ‡ weigh'd,
His threats rang thro' the vale,
A brazen target on his breaſt,
Like poſts § his legs did ſeem.
And his huge ſpear among the reſt,
Was like a weaver's beam.
Whoſe head when weighed true we find
Six hundred Shekels more,
Enough to daunt young *David*'s mind,
Then *Tyro* pray explore,
This Bravo!—This *Philiſtine*'s height
In *Britiſh* meaſure true,
And likewiſe tell his *Coat*'s true weight
In pounds—and *Spear*'s head too.

---

* Of 1 foot 9.888 inches according to Dr. *Arbuthnot*.

† Half a cubit.

‡ Of ½ an ounce Avoirdupoiſe.

§ Alluding to the greaves of braſs upon his legs.

21.888 inches in one cubit 6.5 number of cubits 109440 131328 12) 142.272 } height in { inches 3) 11.856 } height in { feet 3.952 } height in { yards	Then by proceeding as in the last question the 5000 Shekels (or half ounces) *the weight of his coat,* will be found to be 156*lb.* $\frac{1}{4}$ = 1*C.* 1*qr.* 16 *lb.* 4 *oz.* and the 600 Shekels (or half oun-

ces) *the weight of his Spear's head* 18*lb.* $\frac{3}{4}$

Question 3.

Og king of *Bashan*—scripture says
His Iron bedsteads were
In length nine cubits, and the breadth
Was four—it does appear,
The length and breadth I pray unfold,
In *British* measure true,
And area of this Giant's bed,
All this with ease you'll do.

First 9 } cubits, the { length }
and 4 } cubits, the { breadth }
multiplied into 1.824 foot (the length of a cubit) produces 16.416 } the { lth. } of the bedsteads in feet.
and 7.296 } the { bth. } of the bedsteads in feet.

Then (according to the rule at the bottom of *page* 80 for finding the area of a rectangular figure) 16.416 multiplied by 7.296 produces 119.771136 the area in feet, which divided by 9 (the square feet in a square yard) quotes 13.3 + the area in yards.

The

The RULE of THREE in DECIMALS.

RULE.

IN *Decimals* the *Rule of Three*,
As *Integers* must worked be,
Your vulgar fractions turned fair
To Decimals,—then next prepare,
To state and work as taught before,
And you'll the answer soon explore.

EXAMPLE 1.

When two eighths of a pound cost three fourths of a shilling,
The price of four fifths you may find if you're willing.

$$\text{The vulgar fraction}\left\{\begin{matrix}\frac{2}{8}\\ \frac{3}{4}\\ \frac{4}{5}\end{matrix}\right\} = \left\{\begin{matrix}.25\\ .75\\ .8\end{matrix}\right.$$

	lb.	*s.*	*lb.*
Then as	.25 :	.75 ::	.8
		.8	
			s
	.25)	.600 (2.	4
		50	12
			d
		100	4.8
		100	4
		0	$\frac{3}{4}$.2

Answer 2*s* 4*d* $\frac{3}{4}$

EXAMPLE 2.

In a rich *copper mine* we find,
Three fifths was *Jacob*'s share,
Who sold to bonny *Kate* so kind,
Three fourths it does appear;
For seventeen hundred and ten pound,
Of this his right thereto,
What was his share * I pray expound,
Come *Tyro* tell me true.

* Interest in the *mine*.)

 First

First $\frac{3}{4}$ of $\frac{3}{5} = \frac{9}{20} = .45$ being that part of *the whole* which he sold for £1710.

$$
\begin{array}{llcrcl}
 & & & \pounds & & \\
\textit{Then} & \text{If } .45 & : & 1710 & :: & .75 = \tfrac{3}{4} \\
 & & & .75 & & \\
\cline{4-4}
 & & & 8550 & & \\
 & & & 11970 & & \\
\cline{4-4}
 & \multirow{2}{*}{.45\left\{\begin{array}{r} .5) \\ \\ .9) \end{array}\right.} & & 1282.50 & & \\
\cline{4-4}
 & & & 2565.0 & & \\
\cline{4-4}
\end{array}
$$

$$
\begin{array}{lr}
\text{From} & \pounds 2850 \\
\text{Take} & 1710 \\
\cline{2-2}
\text{Rem.} & 1140 \\
\cline{2-2}
\end{array}
\left.\begin{array}{c} \\ \\ \\ \end{array}\right\}
\text{the value of his}
\left\{\begin{array}{l} \text{original} \\ \text{alienated} \\ \\ \text{present} \end{array}\right\}
\text{share}
$$

Or divide £1710 by .45 and the quotient will be £3800 the value of the whole mine, from $\frac{3}{4}$ of which *viz*. £2850 deduct £1710 and the remainder will be £1140 the value of his present share, the same as above.

EXAMPLE 3.

Suppose 12 men mow down a field of grass in $5\frac{3}{4}$ days, how many men (at the same rate of working) will mow down the same in 3 days?

$$
\begin{array}{lrcrcl}
 & \text{days} & & \text{men} & & \text{days} \\
\text{Reciprocally as } 5\tfrac{3}{4} = & 5.75 & : & 12 & :: & 3\,^{*} \\
 & & & 12 & & \\
\cline{4-4}
 & & 3) & 69 & & \\
\cline{4-4}
 & & \text{Answer} & 23 & \text{men} & \\
\cline{4-4}
\end{array}
$$

The

The *Rule of Three* in decimals (respect being had to the pointing) being exactly the same as *that* in Integers, wherein I have given such variety of examples makes it quite unnecessary to give any more in the *Rule of Three* in this place, so shall now give a few examples in the rule of *Practice* by decimals, and then proceed to treat of the *Square* and *Cube Roots*.

PRACTICE IN DECIMALS.

INGENIOUS *Tyro* here you see,
How useful decimals must be,
To all who are concern'd in trade,
All tradesmen sure might crave their aid,
Who wou'd with method quick and fair,
Keep their accompt-books just and clear.

EXAMPLES.

s d
2 6 | $\frac{1}{8}$ | 6783 yards at $\frac{1}{2}$

$\frac{1}{2}$ | $\frac{1}{160}$ | 847.875 | pr. at | *s d* 2 6
14.13125 | | — $\frac{1}{2}$
Answ. £14 2*s* 7*d* $\frac{1}{2}$

5*s* | $\frac{1}{4}$ | 5746*lb.* at $\frac{3}{4}$

$\frac{3}{4}$ | $\frac{1}{80}$ | 1436.5 } pr. at { *s d* 5 —
17.956 } { — $\frac{3}{4}$
Answ. £17 19*s* 1*d* $\frac{1}{2}$

2*d* | $\frac{1}{120}$ | 774 at 1*d*

$\frac{1}{4}$ | $\frac{1}{8}$ | 6.45
.806 } price at { 2*d* — $\frac{1}{4}$
5.644 } { 1 $\frac{3}{4}$
Answ. £5 12*s* 10*d* $\frac{1}{2}$

s d 2 6 | $\frac{1}{8}$ | 714 at 2*d* $\frac{1}{2}$

d 2$\frac{1}{2}$ | $\frac{1}{12}$ | 89.25 | pr. at | 2*s* 6*d*
7.4375 | | — 2$\frac{1}{2}$
Answ. £7 8*s* 9*d*

EXAMPLES.

3*d* | $\frac{1}{8}$|$\frac{1}{0}$ 586.5 (= 586 $\frac{1}{2}$) at 2*d*. $\frac{3}{4}$
$\frac{1}{4}$ | $\frac{1}{12}$ 7.3312
.6109
6.7203 } pr. at { 3*d*. $\frac{1}{4}$ 2 $\frac{3}{4}$
Answ. £6 14*s* 4*d* $\frac{3}{4}$

s *d*
2 6 | $\frac{1}{8}$ 785.75 (= 785 $\frac{3}{4}$) at 3*d* $\frac{3}{4}$
d
3 $\frac{3}{4}$ | $\frac{1}{8}$ 98.2187
12.2773 } pr. at { *s* *d* 2 6 — 3 $\frac{3}{4}$
Answ. £12 5*s* 6*d* $\frac{1}{2}$

6*d* | $\frac{1}{4}$|$\frac{1}{0}$ 678 at 6*d* $\frac{3}{4}$
$\frac{3}{4}$ | $\frac{1}{8}$ 16.95
2.1187
19.0687 } pr. at { 6*d* - $\frac{3}{4}$ 6 $\frac{3}{4}$
Answ. £19 1*s* 4*d* $\frac{1}{2}$

5*s*
d
7 $\frac{1}{2}$ | $\frac{1}{4}$ 754 at 7*d* $\frac{1}{2}$
$\frac{1}{8}$ 188.5 | pr. at | 5*s* — *d*
23.5625 | | 7 $\frac{1}{2}$
Answ. £23 11*s*. 3*d*

5*s* | $\frac{1}{4}$ 876 at 10*d*
d
10 | $\frac{1}{6}$ 219 price at 5*s*
36.5 = £36 10*s*

1*s* | $\frac{1}{2}$|$\frac{1}{0}$ 978 at 13*d* $\frac{1}{2}$
d
1 $\frac{1}{2}$ | $\frac{1}{8}$ 48.9
6.1125
55.0125 | pr. at | 1*s* — *d* — 1 $\frac{1}{2}$ 1 1 $\frac{1}{2}$
Answ. £55 —*s* 3*d*

5*s* | $\frac{1}{4}$ 156.25 (= 156 $\frac{1}{4}$) at 15*d*
s *d*
1 3 | $\frac{1}{4}$ 39.0625 | pr. at | 5*s* — *d*
9.7656 | | 1 3
Answ. £9 15*s* 3*d* $\frac{3}{4}$

s *d*
1 8 | $\frac{1}{12}$ 795 at 17*d* $\frac{1}{2}$
d
2 $\frac{1}{2}$ | $\frac{1}{8}$ 66.25
8.281
57.969 } pr. at { *s* *d* 1 8 — 2 $\frac{1}{2}$ 1 5 $\frac{1}{2}$
Answ. £57 19*s* 4*d* $\frac{1}{2}$

EXAMPLES.

2*s*	$\frac{1}{10}$	157.25 (= 157 $\frac{1}{4}$)		at 2*s* 2*d*	
2*d*	$\frac{1}{12}$	15.725	pr. at	2*s* — *d*	
		1.310		— 2	
		17.035		2 2	
		£17 —*s* 8*d* $\frac{1}{2}$ Answ.			
		874.5 = (874 $\frac{1}{2}$) at 6*s* 8*d*			
8*d*	$\frac{1}{3}$	87.45 pr. at 2*s*			
		3			
		262.35	pr. at	6*s* —	
		29.15		— 8	
		291.5		6 8	
		Answer £291 10*s*			
		Or thus			
s *d* 6 8	$\frac{1}{3}$	874.5			
		291.5 = £291 10*s* Answer as before			

129 at £1 13*s* 4*d*

s		£		£ *s* *d*
10	$\frac{1}{2}$	129	price at	1 — —
3 4	$\frac{1}{3}$	64.5		— 10 —
		21.5		— 3 4
		£215		1 13 4

C. qrs. lb.
249 3 10 $\frac{1}{2}$ at £3 2*s* 8*d* *per C.* See this example in *page* 225. This weight reduced (by *Case* 2 *page* 295.) will stand thus

		249.84375	
		3	£ *s* *d*
		749.53125 at	3 — —
8*d*	$\frac{1}{3}$	24.984375	— 2 —
		8.328125	— — 8
		782.84375 at	3 2 8
		£782 16*s* 10*d* $\frac{1}{2}$ A.	

Or thus

Multiply the given quantity 249.84375 (according to the *Contraction* in *page* 287) by 3.133333 = £3 2*s* 8*d* (the given price) and the product *viz.* the answer, will be £782.8437 the same as above. So that by proceeding according to any of these methods, the value of any quantity of goods may be easily known at any given price. And now before I conclude this *excellent rule*, it may not be amiss to observe to the learner,

learner, that if the given price be a composite number, greater than 12 and an aliquot part of a pound &c. it is oftentimes more concise to divide by its component parts, as may be seen in several of the preceding examples in this rule *viz.*

In the example at (d)	the divisors are	and	the com. parts of	the aliquot part that, the giv. price (d)	is of a pound.
— $\frac{1}{2}$	8	60	480	— $\frac{1}{2}$	
— $\frac{3}{4}$	4	80	320	— $\frac{3}{4}$	
2 $\frac{1}{2}$	8	12	96	2 $\frac{1}{2}$	
3 $\frac{3}{4}$	8	8	64	3 $\frac{3}{4}$	
7 $\frac{1}{2}$	4	8	32	7 $\frac{1}{2}$	
10	4	6	24	10	
15	4	4	16	15	

EXTRACTION of the SQUARE ROOT.

COME *Tyro* haste, your skill exert,
To learn this *Rule* pray be expert,
For *Evolution* points out fair
How roots of squares extracted are,
All this with ease you'll quickly know,
By th' *Table* and the *Rule* below.

TABLE.

Roots	1	2	3	4	5	6	7	8	9
Squares	1	4	9	16	25	36	49	64	81

RULE.

YOUR periods pointed fair and true
Under the first, besure put you
The nearest square you find come to't
And for the quotient place the root,

Then

Then from that period next subtract
Th' aforesaid square to be exact
To this observe next period's brought
The quotient doubled—next is sought
What times that quote contain'd will be
In the resolvend—*Tyro* see
You leave your units place quite free.
Because that place your square supplies,
As th' quoted figure multiplies,
Subtracting next you thus go on,
Until your operation's done,
But if you find your number be
A surd—observe me instantly,
Periods of cyphers bring thereto,
For decimals work nearly true.

EXAMPLE I.

What is the Square Root of 76176?

```
       76176 (276 Root
       4
       ----
47)    361
       329
       ----
546)    3276
        3276
        ----
```

EXPLANATION.

The number being separated or pointed into periods of 2 figures each, then the nearest square number to 7 the first period is 4 which is set under and subtracted therefrom, and 2 the square root of 4 is placed in the quotient, and to the remainder 3 the next period 61 is brought down or annexed which makes 361 for a new dividend or resolvend, to the left hand whereof is placed 4 *viz.* the quotient doubled or multiplied by 2, and as 36 (part of the resolvend) contains 4 (part of the divisor) with what will be carried to the product, 7 times, 7 is set in the quotient and to the right hand of the divisor

divisor also, making it 47 which being multiplied by 7 the product 329 is set under and subtracted from 361 the new resolvend, and to 32 the remainder, 76 the 3d and last period is annexed making ·3276 for another new resolvend, to the left of which is placed 54 the double of the quotient 27, then as 54 is contained in 327 (part of the new resolvend) 6 times therefore 6 is placed in the quotient and likewise to the right of the divisor, making it 546 which being multiplied by the quotient figure 6, the product 3276 is set under the resolvend, and as nothing remains the work is finished and 76176 found to be a square number and 276 its root. Hence it is easy to

OBSERVE

That every Root must consist of as many places of figures as there are periods in the given number, and will be Integers or Decimals respectively as the periods are so, from which they are found or to which they correspond. And also that doubling the unit's figure of each divisor *viz.* adding thereto its unit's figure produces part of the succeeding divisor the same (*and is full as expeditious*) as the before-mentioned method of doubling the quotient, for (in this example) 27 doubled makes 54 (part of the last divisor) and so does the first divisor 47 when added to 7 its unit's figure.

To prove the square root is only to multiply the root by itself thus 276 × 276 = 76176 the given resolvend in this example.

EXAM-

EXAMPLE 2.

Extract the square root of

```
          29506624 (5432
          25         Root
          --
  104)     450
           416
           ---
  1083)     3466
            3249
            ----
  10862)     21724
             21724
             -----
```

EXAMPLE 3.

Extract the square root of

```
      .0001522756 (.01234
          1           Root
          -
  22)     52
          44
          --
  243)     827
           729
           ---
  2464)     9856
            9856
            ----
```

EXAMPLE 4.

Extract the square root of 5467.184.

```
          5467.1840 (73.9404084 &c.
          49
          --
    143)   567
           429
           ---
   1469)   13818
           13221
           -----
   14784)    59740
             59136
             -----
   1478804)    6040000
               5915216
               -------
  147880808)    1247840000
                1183046464
                ----------
  1478808164)     6479353600
                  5915232656
                  ----------
                   564120944
                   ---------
```

In the given number of this example there being but 3 decimals, a cipher was annexed to make 'em up an even number, in order that they might be divided into periods as before, and when any number to be extracted is (like *this*) not a square but irrational, periods of ciphers may be added at pleasure,

pleasure, and the further you proceed, the more exact will the root be, but for common purposes 4 places of decimals are sufficient.

But when the root is to be extracted to a great number of places, the work may be much abbreviated thus, proceed by the common method till you have one figure more than half the number there is to be in the root; then divide the remainder (according to the *contraction* in division of decimals *page* 292) by the double root except the right hand figure, and the quotient will be the remaining part of the root, as in this example, the remainder after multiplying by the 6th figure in the root is 124784 which being divided (agreeable to the above-mentioned *contraction*) by 147880 (the corresponding divisor or double of the root except the right hand figure) quotes 084 &c. the remaining part of the root as in the preceding *page*.

COROLLARY.

When the Square Root *of any* vulgar fraction *is required*—Take the Root of the numerator and denominator if the fraction be a complete power, thus the Square Root of $\frac{25}{81}$ is $\frac{5}{9}$, but if the fraction be not a complete power, then reduce it to a decimal and proceed as herein before taught.

The USE of the SQUARE ROOT.

To find a mean proportional *between any two given numbers.*

RULE

To find a mean proportional
Of any numbers great or small
The square root of their product true
Brings out an answer to your view.

Question

Question 1.

Find a mean proportional between 36 and 64.

First 36 × 64 = 2304 *then* 2304 (48 Answer,
```
              2304 (48
              16
              ----
         88)  704
              704
              ----
                0
```

Proof
As 36 : 48 :: 48 : 64

Question 2.

If th' area of a circle be
As in the margin * you may see * 33124
What is the side then of a square,
Equal in area, pray declare.

The square root of 33124 = 182 the Answer.

Question 3.

To humble *France*, suppose a Gen'ral sent
With a fine army o'er the continent,
Whose number just of valiant fighting men,
Is forty thousand, four hundred and one,
How many men in rank and file must be
To form a square battalia tell to me.

The square root of 40401 = 201 the Answer.

Question 4.

A set of true Britons all jovial and free,
Were drinking full bumpers to dear LIBERTY,
Till the reck'ning came to the sum * here subjoin'd * 17 1 4
The number of persons,–haste *Tyro* and find,
Whose share must be equal, this tell unto me,
No doubt but *Mæcenas* will smile upon thee.

D d

£	s	d		farthings	
1	–	– $\frac{1}{4}$	=	961	(31 men Answer
				9	
				61) 61	
				61	
				·	

	men		farthings		man		d	
If	31	:	961	::	1	:	7 $\frac{3}{4}$	each man's share.

PROMISCUOUS QUESTIONS.

Question 1. By Mr. *Rob. Wilson, Ladies Diary* 1713.

A castle wall there was whose height was found
To be one hundred feet, from th' top to th' ground,
Against the wall, a ladder stood upright,
Of the same length, the castle was in height.
A waggish fellow did the ladder slide
(The bottom of it) ten feet from the side.
Now I would know how far the top did fall,
By pulling out the ladder from the wall.

$$\left.\begin{matrix}100\\10\end{matrix}\right\}\text{squared} = \left\{\begin{matrix}10000\\100\end{matrix}\right.$$

Difference 9900 the square root whereof *viz.* 99.498+ feet, is the height of the wall to the top of the ladder after it was pull'd out, which being deducted from 100 feet the whole height of the wall, leaves .502 *viz.* a little more than *half a foot*, the answer.

Question

Question 2. By Mr. *Massey*. *Ladies Diary*, 1716.

A wealthy *Knight* in *Lincolnshire* resides,
Whose fields are wash'd by the redundant tides
Of *Witham's* crystal stream; his chiefest care
Pomona like is now to bless the year;
With fruitful products from the teeming tree,
For none more vers'd in rustic cult' than he.
Oblong in form, extended from his house,
He did a closure for his garden chuse
With chosen walnut plants, he set it round
At once to shade his walks and load the ground,
Succeeding Summers, with prolific heat,
Manur'd the infant trees, and made them great.
That they expand their tow'ring heads in air,
And store of barricaded kernels bear;
September last the *Knight* his man employ'd.
To gather all the nuts his trees supply'd,
The man returns and with mysterious phrase
Premeditated to his master says.
Sir, your commands, I willingly obey'd,
And as I wrought, this observation made,
On ev'ry tree so many boughs are found,
As there are trees in all your garden round,
Nine of these trees as many walnuts bear,
As upon all the trees there branches are,
If that you multiply this sum by three,
You in the product all the nuts may see. (2187)
What *Sir*, from this account I humbly crave
Is that you tell how many trees you have,
The *Knight* unskill'd in such conceits as those,
Took up the nuts, and smiling off he goes;
But turning short again, says, hark you *Nat*,
Send Mr. *Tipper's* correspondents that.

3) 2187

Boughs 729 (27 trees Anſwer
4

47) 329
329

trees nuts trees nuts
If 9 : 729 :: 27 : 2187.

EXTRACTION of the CUBE ROOT.

A *Cube* (I ſay) to tell you true,
Contains length, breadth, and thickneſs too,
A *Cube*'s a figure you may ſee,
Derived from *Geometry*.
How to extract in ev'ry part,
And find the root——pray get by heart
The following *Table* which you view,
And *Rule* I here preſent to you.

TABLE.

Roots	1	2	3	4	5	6	7	8	9
Squares	1	4	9	16	25	36	49	64	81
Cubes	1	8	27	64	125	216	343	512	729

RULE.

" The cube of your firſt period take,
" And of its root a quotient make."
Subtract this cube and what you find
To be the diff'rence, left behind,
To that bring down th' next period true,
Your dividend appears in view.
A true diviſor next to find,
Firſt to the quote, a cypher's join'd,
Then call it *R*, and let that be,
Firſt ſquar'd, then multiply'd by *three*,

Now

Now ask how oft this number can
Within the dividend be ta'en
The quote call *S*, then by it you
Must multiply the divisor too,
This product you must write down plain
Under the dividend — again
Next multiply your *R* by *three*,
And that by th' square of *S* must be
Involv'd, put down, the root t' express,
Write under that the cube of *S*.
These sums being added up and penn'd,
Subtract them from your dividend,
To what remains th' next period's brought,
If any more, or roots are sought.

EXAMPLE I.

What is the Cube Root of 32768 ?

$$\begin{array}{rl} 32768 & (32 \text{ Root.} \\ 27 & \\ \hline \end{array}$$

$$30 \times 30 \times 3. = 2700) \; 5768 \text{ Dividend.}$$

$$\left.\begin{matrix} R \\ S \end{matrix}\right\} = \left\{\begin{matrix} 30 \\ 2 \end{matrix}\right. \qquad \begin{array}{rl} 5400 & = 30 \times 30 \times 3 \times 2 = R^2 \times 3 \times S \\ 360 & = 30 \times 3 \times 4 = R \times 3 \times S^2 \\ 8 & = 2 \times 2 \times 2 = S^3. \\ \hline 5768 & \text{subducend} \end{array}$$

EXPLANATION.

The nearest cube to 32 the first period is 27, which is set under and subtracted therefrom, and 3 the root of the said cube is placed in the quotient, and to the remainder 5, the period 768 is annexed which makes 5768 for a dividend, then a cipher is joined to the quotient figure 3 making it 30 which is call'd *R*, and

being ſquared and that ſquare multiplied by 3 produces 2700 for a diviſor which being contained twice in the dividend, 2 is placed in the quotient and called *S* by which the diviſor is multiplied and the product 5400 ſet under the dividend, then 3 times $R = 90$ is multiplied by 4, the ſquare of *S*, and the product 360 is placed under the 5400, and laſtly 8 the cube of *S*, is placed under, and added to the other two numbers under the dividend, and the ſum 5768 being the ſame as the dividend and no more periods to be brought down the work is finiſhed, 32768 found to be a cube number and 32 its cube root.—To prove the cube root is only thrice involving the root into itſelf *viz.* multiplying the root by itſelf and that product or ſquare by the ſame root again, thus, the cube of 32 is $32 \times 32 \times 32 = 32768$ the given reſolvend in this example.

EXAMPLE 2.

What is the cube root of 242970624?

$$
\begin{array}{lr l}
 & 242970624 & (624 \text{ root.} \\
 & 216 & \\
\hline
R^2 \times 3 = 10800) & 26970 & \text{dividend} \\
\hline
\left.\begin{array}{l} R \\ S \end{array}\right\} = \left\{\begin{array}{l} 60 \\ 2 \end{array}\right. & 21600 & = R^2 \times 3 \times S \\
 & 720 & = R \times 3 \times S^2 \\
 & 8 & = S^3 \\
\hline
 & 22328 & \text{ſubducend} \\
\hline
R^2 \times 3 = 1153200) & 4642624 & = \text{2d. dividend} \\
\hline
\text{Here } \left.\begin{array}{l} R \\ \text{and } S \end{array}\right\} = \left\{\begin{array}{l} 620 \\ 4 \end{array}\right. & 4612800 & = R^2 \times 3 \times S \\
 & 29760 & = R \times 3 \times S^2 \\
 & 64 & = S^3 \\
\hline
 & 4642624 & \text{ſubducend} \\
\hline
\end{array}
$$

EXAMPLE 3.

The side of a cubical vessel define,
T' contain less nor more than four gallons of wine.

A gallon of wine being 231 solid Inches (see *page* 20) then four gallons must be 4 times as many *viz* 924 (9. 739 Root or side of the vessel.

729

24300) 195000

170100
13230
343

183673

Here R } = { 90 ; S } = { 7

2822700) 11327000

8468100
26190
27

8494317

Here R } = { 970 ; and S } = { 3

284018700) 2832683000

2556168300
2364390
729

2558533419

27414958I

Here R } = { 9730 ; and S } = { 9

In this example you may observe that tho' the *first divisor* is contained 8 times and the *second*, 4 times, in their respective dividends, yet only 7 and 3 are placed in the quotient or root because subducends produced from 8 and 4 would be too much *viz.* greater than the dividends.—*To extract the Cube Root of a vulgar fraction* observe the directions given for extracting the Sqr. Root thereof, in *page* 312 only use the Cube Root instead of the Squr. Root.

SCHOLIUM.

The foregoing method of extracting the cube root being very practical and easy to be understood, I shall now shew how to perform the same by easy divisions and an extraction of the square root.—Suppose any number at pleasure which you think will come pretty near the root, but less; divide the resolvend by 3 times the supposed number, from the quotient deduct $\frac{1}{12}$ of the square of the supposed root, and to the square root of this remainder add half the supposed root, and the sum will be the true root.

EXAMPLE 1.

What is the cube root of 32768?—See this example page 317.

Suppose the root to be 30 which multiplied by 3 produces 90 whereby dividing 32768 quotes 364.08 &c.

From which deduct $\frac{1}{12}$ of 900 (the sqr. of the supposed root) viz. 75

and the remainder is 289,08 &c.

289 (17
1 15 = half the
— suppo. root.
27) 189 32 Answer the
189 — same as in
— page 317.

EXAMPLE 2.

What is the cube root of 242970624?—See this example page 318.

Suppose the root to be 600 which multiplied by 3 produces 1800 by which dividing 242970624 quotes 134983.68

From which deduct $\frac{1}{12}$ of 600 × 600 viz. 30000

Remainder 104983.68

$\sqrt{104983} \} = \{ 324$
$\frac{1}{2}) 600 \} = \{ 300$

Answ. 624 the same as in page 318.

The

The extraction of Roots of higher powers being of little or no use in practical arithmetic I shall therefore give no general rule for their extraction but only just observe to the learner that most of them may be wrought by observing what Integer numbers multiply'd together will produce the index of the required Root and making such extractions as are denominated by those numbers thus, 2 the index of the Square Root multiplied by 2 produces 4 the index of the biquadrate Root therefore for that Root extract twice the Square Root, for the sixth Root

$\left.\begin{array}{l}\text{Extr.}\\ \text{Or}\end{array}\right\}$ the $\left\{\begin{array}{l}\text{Sqr.}\\ \text{Cube}\end{array}\right\}$ Root and then the $\left\{\begin{array}{l}\text{Cube}\\ \text{Sqr.}\end{array}\right\}$ Root of that.

because the Indices of those Roots *viz* 2 and 3 multiplied together make 6 the Index of the required Root, so for the eighth Root extract thrice the square Root, the cube or third power of 2 (the Index of the square Root) being 8, and for the ninth Root extract twice the cube Root because 3 its Index raised to the second power *viz*. multiplied by 3 produces 9 the Index of the Root required, and so on as far as you please.

I shall now give a few questions to shew the use of the *Cube Root* in some few particulars and then proceed to treat of *Simple* and *Compound Interest*.

The

The Use of the CUBE ROOT.

Question 1.

Find two mean proportionals between two extremes 5 and 135

5) 135 (27. whose cube Root is	3
	5 the less exteme.
Proof	—
As 5 : 15 :: 45 : 135	15 less mean.
	3
	—
	45 greater mean.

Here the greater extreme is divided by the less, and the cube Root of that quotient multiplied by the less extreme, gives the less mean which multiplied by the said cube Root gives the greater mean, as above.

Question 2.

Sawney a youth, with an accomplish'd air,
Long courted *Moggy*, delicate and fair,
To gain her friendship ev'ry art essays,
To meet her kindness tries a thousand ways,
A glob'lar silver snuff-box *Sawney* buys,
And gives his *Moggy* with unfeigned sighs,
Which cost a guinea as it does appear,
Three inches just was the diameter,
Now *Sawney* thinks the box was rather small,
Soon the silver smith again does call
To change the box—an inch and quarter more
Was the diameter than that before.
Now *Tyro* tell me what the snuff box cost,
And then of your expertness you may boast.

First

First 3 } the diam. of the { 1st } Box cu- { 27 } Inc.
And 4.25 } { 2d } bed is { 76.7656 }

Then as all like solids are in triple proportion to their homologous sides, diameters, lines &c. the proportion is.

	CD	s	£		C D
As	27 :	21 =	1.05	::	76.7656
					1.05
					3838280
					7676560
			27 { 3)		80.60388
			9)		26.86796

Answer £ 2.98532 = 2 £ 19 s 8 d

Question 3.

A Farmer lent his neighbour *Gay*,
To serve him in his need;
Just sixteen feet of good old hay,
In length, breadth, depth indeed.
The neighbour brings him twice we find,
Eight feet * it was no more,
What was the diff'rence left behind,
Come *Tyro* now explore?

$16 \times 16 \times 16 = 4096$ } solid feet { borrow'd
$8 \times 8 \times 8 \times 2 = 1024$ } solid feet { repaid

Answer 3072 } solid feet { unpaid

PROMIS-

* In length breadth and depth each time.

PROMISCUOUS QUESTIONS.

Question 1. By Mr. *Hill.*

If a Ship of 100 tuns be 44 feet long at the keel, of what length shall the keel of that Ship be, whose burthen is 220 tuns?

First 44 × 44 × 44 × 220 = 18740480 which being divided by 100 quotes 187404.8 the cube root whereof is 57.22592 feet the answer.

Question 2. By Mr. *J. Fish* of *Crowl, Martin's Misc.* What dimensions must I give to a joiner, to make a cubical Box that will hold 2000 Oranges of 2 $\frac{1}{2}$ Inches diameter each, supposing the Oranges Globular, keeping that form, and laid in rows exactly at the top of each other.

Solution.

First 2.5 × 2.5 × 2.5 = 15.625 the solidity of one cube which being multiplied by the number of oranges produces 31250 the solidity of the 2000 cubes, or that of the box.

Then $\sqrt[3]{31250} = 31.5$ inches *fere* the side of the box.

SIMPLE INTEREST.

TYRO advance! with skill prepare,
To calculate your Int'rest fair;
And find the gain, *per cent, per annum,*
Of sums lent out by *Aunt* or *Grannum.*
By *Simple Int'rest* you will find,
Much knowledge to enlarge the mind.
The *Principal* and *Int'rest* count,
The sum of both makes the *Amount.*

By

By *Simple Int'rest* we shall shew
How to make calculations true,
In *Fact'rage*, *Brokage*, and *Insurance* too,
And *purchasing Stocks*, as you will find,
In th' pages hereunto subjoin'd.

RULE.

To find the Int'rest for a year,
To multiply you must prepare
The principal by th' rate that's given,
The sum *per Cent*. be't odd or even;
Then lastly by *one hundred* you
Before divide th' product true,
The answer will appear in view.
If Int'rest for more years than one
Shou'd be requir'd 'tis quickly done,
The first year's Int'rest multiply
By th' whole * the answer you'll descry,
For part or parts, the sum t'obtain,
Take parts thereof, of one year's gain;
And if for months, the Int'rest you
Require :—observe this maxim true,
In al'quot parts; the months divide,
The answer may be soon espy'd.
And if for weeks, be more or less,
Which al'quot parts, will not express;
The number multipli'd must be
By th' Interest of a year—you'll see
If you divide by *fifty two*,
The quotient will your answer shew.
For days,—observe to multiply
By one year's Int'rest you'll descry
An answer—when you last divide
By th' days, that's in one year beside.

* Number of years.

EXAMPLE I.

What is the Intereſt of 300 Guineas for a year, at £5 *per Cent?*

£	£	£	
As 100 :	5 ::	315	= 300 Guineas
		5	
		£ 15|75	
		|20	
		s |—	
		15|0	

Note. The dividing by 100 in this and the following examples (where needful) is performed by cutting off the figures with a ſtraight line. See the reaſon *page* 291.

2d. By *Practice.*

£	£
$5 = \frac{1}{20}$)	315
Anſwer	£15 15*s*

3d. By *Decimals*

£	
315	principal
.05	ratio
Anſw. 15.75 = £15 15*s*	

The above example is worked by 3 different methods, to ſhew the conciſeneſs of each.—The ratio or rate of £1 for a year at the given rate is thus found. As £100 : £5 :: £1 : £.05 and ſo may any other ratio be found as in the annexed table.

TABLE

Rate		*Ratio*
3		.03
3 ½		.035
3 ¾		.0375
4	=	.04
4 ¼		.0425
4 ½		.045
5		.05

Note. Lawful Intereſt is £5 *per cent. per annum,* that is £5 for the uſe or Intereſt of £100 for a year or 12 months.

EXAMPLE

EXAMPLE 2.

At Simple Interest tell me plain,
What fourteen thousand pound will gain;
At three pound ten *per cent. per annum*,
For seven years to please a *Grannum*.

```
      £
½) 14000
      3½
   -----
   42000
    7000
   -----
     490 Int. for 1 yr
       7 No. of yrs.
   -----
Answ. 3430
```

By *Decimals*.

```
     £
  14000 principal
   .035 ratio
  -----
  70000
 42000
 ------
    490 Int. for 1 yr.
      7 No. of yrs.
  -----
 £3430 Answer
```

EXAMPLE 3.

What is the Interest of £206 12*s* for 4¼ years, at £5½ *per cent. per annum*?

```
£     £    s
5|1/20|206  12
s      ---------
10|1/10| 10   6   7  }            { £5  –  }
          1   –   7¾ } Int. for a {  –  10 } per Cent.
       -----------   } year at    {  ----- }
         11   7   2¾ }            {  5  10 }
                  4¼ No. of years
       -------------
         45   8  11  }          { 4 years
          2  16   9½ } Int. for {   ¼
       ------------- }          {  ----
Answer £48    5   8½ }          { 4¼ years.
```

EXAMPLE 4.

What will £342 amount to in 10 months at £5 *per Cent. per Annum.*

£ £
5 | $\frac{1}{20}$ | 342

6 *mo.* | $\frac{1}{2}$ |
4 *mo.* | $\frac{1}{3}$ | 17 2*s* In. for 1 yr.

To 8 11 } Int. for { 6 } months
Add 5 14 } { 4 }
{ 10 }
Th. to 14 5
Add 342 — the princi.

£356 5 Answ.

EXAMPLE 5.

What is the amount of £400 for 13 weeks, at £4$\frac{3}{4}$ *per Cent. per Annum?*

£
400
4$\frac{3}{4}$

1600
300

$\frac{1}{4}$) 19 | } Int. for } 1 yr.

To 4 15 } the { 13 w
Add 400 — { princip.

An. £404 15 } amount

EXAMPLE 6.

What is the Interest of £68 5*s* 8*d* for 3 years and 7 months, at £4 5*s per Cent. per Annum?*

£ *s d*
$\frac{1}{4}$) 68 5 8 £ *s*
4$\frac{1}{4}$ = 4 5

273 2 8
17 1 5

* £2 | 90 4 1
20

*s*18 | 04
12

d— | 49
4

$\frac{1}{4}$ | 96

£ *s d*
* 2 18 — $\frac{1}{4}$ Int. for 1 yr.
3

6 *mo.* | $\frac{1}{6}$ | 8 14 — $\frac{3}{4}$ } Interest for { 3 years
1 *mo.* | $\frac{1}{6}$ | 1 9 — { 6 months
4 10 { 1 month

Anf. £10 7 10$\frac{1}{4}$ } { 3yrs. 7 m.

EXAM-

EXAMPLE 7.

What will £700 15s amount to in 30 weeks at £4½ *per Cent. per Annum?*

```
     £       £  s
  700.75 = 700 15
    .045  Ratio
  ------
  350375
 280300
 --------
 31.53375  Interest for 1 year
       30                £  s  d
 --------
52) 946.0125 (18.1925 = 18  3 10
 -------      Principal  700 15 -
                        ---------
              Answer £718 18 10
```

EXAMPLE 8.

From *January* th' tenth, in a *Bissextile* Year,
To *December* the eighteenth, I pray make appear,
What th' amount of six hundred bright Guineas will be
At four and a half *per Cent.* * tell unto me?

```
  £     Guin.
 630 = 600 Principal
 .045 Ratio
 ----
 3150
2520
 ----
28.35 Int. for 1 year
  343 Days
 -----
 8505
11340
8505      £        £  s  d
365) 9724.05 (26.6412 = 26 12 9¾ }     { Int.
                       630 -- -- } the { Prin.
             Answer £ 656 12 9¾  }     { Amount
```

Note. This question or any other of the kind may be easily answered by the help of the decimal table in the following *page*.

* *Per Annum.*

Or by the help of the annext table, thus

The tabular number—.00012328767 multiplied by £ 630 the principal, and that product by 343 the number of days, produces £26.6412 &c. = 26 £ 12 *s* 9 *d* $\frac{3}{4}$ the interest the same as in *page* 329.

TABLE.

Rate *per Cent.*		Int. of £ 1 for a Day
£		£
3	=	.000082191 78
$3\frac{1}{2}$	=	.00009589041
4	=	.00010958904
$4\frac{1}{2}$	=	.00012328767
5	=	.0001369863
$5\frac{1}{2}$	=	.00015068493
6	=	.00016438356

EXAMPLE 9. *For the Ladies.*

Old *Jerry*, had a daughter gay,
Whose wit and charms might vie,
With *Flora*, goddess of the May,
Or blooming *Margery*.
Young *Hodge*, a jocund country swain,
When tripping thro' the grove,
Oft sigh'd, and wish'd this maid to gain,
His thoughts were built on love.
At length he gain'd the maid's consent,
To visit *Hymen*'s shrine,
And to the Church they straightway went,
Where love and friendship join.
Old *Jerry*, (like a father) kind,
Gave to them as appears,
A sum, at int'rest as we find,
Had been for seven years
And threescore days as writings shew,
The sum five hundred pound;
When first put out, believe it true,
(Here kindness did abound.)
At simple int'rest *Ladies* find,
Th' amount of this their store,
Which pleas'd the happy pair so kind,
At five *per Cent*. * explore,

* *per Annum*.

RULE

	£	s	d	the Interest for
First 500 × .05 = £25 the Int. for 1 year which being multiplied by 7 the number of years, produces	175	—	—	7 years
Dys £ Dys As 365 : 25 .: 60 60 365) 1500 (4.1095 &c. =	4	2	$2\frac{1}{4}$	60 days
Then to	179	2	$2\frac{1}{4}$	7 ys & 60dys
Add	500	—	—	Principal
Answ.	679	2	$2\frac{1}{4}$	Amount

Or, the Interest for the 60 days may be found by the help of the *Table* in *page* 330 thus .0001369863 the tabular number at £ 5 *per Cent*. multiplied by 60 and that product by £500 the principal, produces £4.1095 &c. = £4 2*s* 2*d* $\frac{1}{4}$ the Interest for the 60 days, the same as above.

COROLLARIES.

Cor. 1. *When the* interest, rate, *and* time, *are given to find the* principal.—Divide the interest, by the product of the ratio and time, the quote is the principal.

Cor. 2. *When the* amount, rate, *and* time, *are given to find the* principal.— To the product of the raito and time add *unity*, by which sum divide the amount, the quote is the principal.

Cor. 3. *When the* principal, interest, *and* rate, *are given to find the* time.—Divide the interest by the product of the principal and ratio, the quote is the time.

Cor.

Cor. 4. *When the* principal, interest, *and* time, *are given to find the* rate, *per Cent.*—Divide the interest by the product of the principal and time, the quote is the ratio.

EXAMPLE 10.

What principal put out to interest for 4½ years will gain £58 14*s* 6*d* at £4 *per Cent. per Annum?*

By Cor. 1. *Page* 331.

$$\begin{array}{llll} \text{Time} & 4.5 & & \\ \text{Ratio} & .04 & .18\left\{\begin{array}{l} .2)\ 58.725 = £58\ 14s\ 6d \text{ the Interest} \\ .9)\ 293.625 \end{array}\right. & \\ \text{Prod.} & .18 & \text{Answ.}\ £326.25 = £326\ 5s & \end{array}$$

EXAMPLE 11.

To pay a debt of forty pound,
Which three years hence is due,
What present money pray expound,
At *five per Cent.* will do?

By *Cor.* 2. In the preceding *page.*

$$\begin{array}{l} .05 \\ 3 \\ \hline \end{array}$$

Product of rate and time *plus* unity } 1.15) 40.0 (34.7826 = £34 15*s* 7¾*d* Answ.

EXAMPLE 12.

In what time will £500 gain £120 at £6 *per Cent. per Annum?*

By *Cor.* 3. In the preceding *page.*

$$\begin{array}{lll} \text{Principal} & 500 & 3|0)\ 12|0 \text{ Interest} \\ \text{Ratio} & .06 & \\ & & \text{Answer}\quad 4 \text{ years} \\ \text{Product} & 30. & \end{array}$$

EXAM-

EXAMPLE 13.

In what time will two hundred *Moidores* raise,
(At simple int'rest,) tell me if you please,
A stock of just four hundred *Ports* define,
At three *per Cent.* in royal *British* coin.

		£ s		£		
First 400 Ports	at	1 16	a piece =	720	the	St. or Am.
and 200 Moids.		1 7		270		Principal
			Remains	450		Interest

Then by *Cor.* 3. *Page* 331.

£		£
Principal 270		9) 450 Interest
Ratio .03	8.1	.9) 50
Product 8.1		Answ. 55.55 &c. = $55\frac{5}{9}$ yrs.

EXAMPLE 14.

At what rate *per Cent.* will £216 10s gain £43 6s in 4 years.

By *Cor.* 4. In the preceding *page*.

Principal £216.5
Time 4

Product 866.)£43.30(£.05 Ratio
43 30

Answ, £5.

EXAM-

Example 15.

At what rate *per Cent.* will £643 2*s* 6*d* amount to £787 16*s* 6*d* ¼ in 5 years.

$$
\begin{array}{ll}
 & \pounds \\
\textit{1st.}\ \text{From} & 787.828125 \\
\text{Deduct} & 643.125 \\
\hline
\text{Remains} & 144.703125 \\
\hline
\end{array}
\left.\vphantom{\begin{array}{l}1\\1\\1\\1\\1\end{array}}\right\}=\left\{
\begin{array}{lll}
\pounds & s & d \\
787 & 16 & 6\tfrac{1}{4} \\
643 & 12 & 6 \\
\hline
144 & 14 & -\tfrac{3}{4} \\
\hline
\end{array}\right\}\text{the}\left\{\begin{array}{l}
\text{Am.} \\
\text{Pr.} \\
\\
\text{Int.}
\end{array}\right.
$$

Then by *Cor.* 4 *Page* 332.

$$
\begin{array}{llll}
 & \pounds & & \\
\text{Principal} & 643.125 & & \\
\text{Time} & 5 & & \\
\hline
 & & \pounds & \text{Ratio} \\
\text{Product} & 3215.625) & 144.703125(& .045 \quad \text{Answ.}\ \pounds 4\ 10s
\end{array}
$$

Scholium.

Having given variety of examples to shew the ingenious learner how to proceed with Simple Interest, I shall now add a few examples concerning *Factorage*, or *Commission*, *Brokage*, *Insurance*, and purchasing *Stocks*, and then proceed to *Compound Interest*, or *Interest* upon *Interest*.

Factorage, *Provision*, or *Commission*, is an allowance that is generally made to agents, or factors beyond Sea, for buying or selling of goods, at a given or certain rate *per Cent.* according to the custom of the country the factor, or merchant resides in.

Brokage, is an allowance made to brokers, or any person who is employed to assist others in buying, or disposing of their goods, and in *London* are not to act without the *Lord-Mayor*'s licence.

Insurance,

Insurance, is security given by persons who oblige themselves to answer for the loss or damage of ships, houses, goods &c. by storms, pirates, fire, &c. in consideration of a premium paid down to restore whatsoever value the premium is advanced for by the proprietors of the thing injured.

Stocks are the public funds of the nation, the shares whereof are transferable from one person to another, and occasion that extensive business called *Stock-jobbing*, or (as Mr. *Hutton* in his Schoolmasters Guide, justly remarks) the worst kind of Gaming.

EXAMPLE 16.

What is the commission of £649 10*s* at £3 ¼ *per Cent*?

£ *s*	Or thus
¼) 649 10	649.5
3 ¼	.0325
1948 10	32475
162 7 6	12990
	19485
£21 | 10 17 6	£ *s* *d*
20	Ans. 21.10875 = 21 2 2
2*s* | 17	the same as before.)
12	
2*d* | 10	
Answer £21 2*s* 2*d*	

EXAM-

Example 17.

What is the brokage tell me true
Of what you in the margin view, * — £1000 10s 6d
Allowing sev'nty pence, † not more, — † *per Cent.*
Ingenious *Tyro* this con ∫der.

£	s	d
10|00	10	6 $\frac{1}{4}$
	12	
d	—	
1|26		
4		
—		
$\frac{1}{4}$|06		

		£	s	d
5s	$\frac{1}{4}$	10	—	1 $\frac{1}{4}$
d				
10	$\frac{1}{6}$	2	10	— $\frac{1}{4}$
			8	4
	An.	£ 2	18	4 $\frac{1}{4}$

the brokage at

£	s	d
1	—	—
—	5	—
—	—	10
—	5	10

per Cent.

Example 18.

Suppose I make an Insurance of goods &c. to the value of £4960 at 4s 6d *per Cent per Annum*, what doth the Insurance come to?

£	
49|60	
20	
s | —	
12|00	

s		£	s	d
4	$\frac{1}{5}$	49	12	—
d				
6	$\frac{1}{8}$	9	18	4 $\frac{3}{4}$
		1	4	9 $\frac{1}{2}$
	An.	£ 11	3	2 $\frac{1}{4}$

the Insur. at

£	s	d
1	—	—
—	4	—
—	—	6
—	4	6

per Cent.

Example 19.

Admit an *East-India* Ship be valued at £12768 15s what is the Insurance, supposing it to be at £15 $\frac{3}{8}$ *per Cent?*

First £12768 15s = £12768.75, and £15 $\frac{3}{8}$ = £15.375

Then £12768.75 multiplied (according to the *contraction* in *page* 287) by 15.375 produces £196319.5 which being divided by 100 *viz.* the decimal point removed 2 figures farther to the left hand (see *page* 291 quotes £1963.195 = £1963 3s 10d $\frac{3}{4}$ the Answer.

EXAMPLE 20.

What is the purchase of £460 *South Sea Stock*, at £116 4*s per Cent?*

s		£		£	s	d			£	s	
4	= 1/5	460	To	460	–	–	the purchase	at	100	–	*per Cent.*
		16	Add *	74	10	4 ¾			16	4	
		7360	Answ.	534	10	4 ¾			116	4	
		92									

£	* 74	52
		20
s	10	4
d		12
	4	8
		4
	¾	2

EXAMPLE 21.

What is the purchase of £ 12768 15 *s Bank Annuities* at £84 ⅝ *per Cent?*

The given rate wanting but £15 ⅜ of being at *Par* or *Cent. per Cent.* therefore

			£	s	d			£	
From	the	giv. sum	12768	15	—	the purch.	at	100	*per Cent.*
Dedt.	the	Ans. to exam. 19 *p.* 336 *viz*	1963	3	10 ¼			15 ⅜	
		Rems.	£10805	11	1 ¼			84 ⅝	

PROMISCUOUS QUESTIONS.

Question 1. by Mr. *Clare.*

Lent 109 Guineas at £4 *per Cent.* which by the 18th of *August* 1760, was raised by the interest to so many Moidores bating 2*s* 6*d* pray on what day did the bond bear date?

		£	s	£	
First 109 Guineas	=	114	9	=114.45	the Principal
and 109 Moidores	=	147	3		from which abate 2*s* 6*d*

and the Amount is £147 –*s* 6*d* from which deduct the Principal, and the remainder will be £32 11*s* 6*d* = £32 575 the Interest.

Then by *Cor.* 3. *page* 331.

114.45
.04

Years

4.578)32.575(7.11555 = 7 years and 42 days, the time the 109 guineas were out at interest, and which time the question says expired on the 18th *August*, 1760.—Now to 31 the number of days in the preceding month *July*, add the 18 days in *August*, and the sum will be 7 days more than 42, whereby it is plain that the bond was dated 7th *July* 1753, for from that time to 7th *July* 1760 are 7 years, and from 7th *July* 1760 to 18th *August* following are 42 days, which together make 7 years and 42 days, as above.

Question 2. by Mr. *James Hardy*.

See (that excellent treatise) his Elements, or Theory of Arithmetic, *page* 303.

A man lent his friend £750 for one year; in the mean time being in want of cash, he disposed of some South-Sea Stock; upon going to replace it, found the market had rose, so that he was a loser of £27 14*s* 8*d* $\frac{1}{4}$ which he resolved his friend should make good for the use of the money lent to him: It is required to find how much he was charged *per Cent. per Annum?*

	£	s	d		£
First	27	14	8 $\frac{1}{4}$	(the Interest) =	27.734375

Then by *Cor.* 4. *page* 332.

	£	s	d
750)27.734375(.03697916 Ratio =	3	13	11 $\frac{1}{2}$

the Rate required.

COM-

COMPOUND INTEREST.

THIS rule compounded does appear,
Because the Int'reſt ev'ry year
Is not receiv'd—but added to
The principal, 'till more is due.
This Int'reſt upon Int'reſt we
May truly call—but as you ſee
It is not lawful ſo to be.

RULE.

The firſt year's Int'reſt you muſt find,
In which the principal is join'd
Or added to, the ſum will be,
A ſecond principal you'll ſee;
And thus you muſt advance on ſtill
For any years, be what they will,
The given principal ſubtract,
From th' laſt amount to be exact;
And the remainder you will find,
Will give the Int'reſt to your mind.

EXAMPLE 1.

What is the Compound Intereſt of £268 forborn 3 years at £5 *per Cent. per Annum?*

£		
268		
1.05		
1340		
2680		
281.4	firſt	year's amount
1.05		
14070		
28140		
295.47	ſecd.	year's amount
1.05		
147735		
295470		
310.2435	third	year's amount
268.	principal	
42.2435 = £42 4s 10¼d	(Anſwer	

Or thus

£	£		
5 = $\frac{1}{20}$)	268	1ſt ys	prin.
	13.4	1ſt ys	Intereſt
$\frac{1}{20}$)	281.4	2d ys	prin.
	14.07	2d ys	Int.
$\frac{1}{20}$)	295.47	3d ys	pr.
	14.7735	3d ys	Int

From	310.2435	the amt.
Dedt	268.	the 1ſt pr
Rem.	£42.2435	the Intr.

EXAMPLE 2.

What is the Compound Intereſt of £794 12s 6d forborn 4 years at £4 *per Cent. per Annum?*

Firſt £794 12s 6d = £794.625. *Then* 794.625 × 1.04 × 1.04 × 1.04 × 1.04 = 929.598 &c. = £929 11s 11d ½ the amount, from which deduct £794 12s 6d the principal, and there will remain £134 19s 5d ½ the Intereſt.

EXAMPLE

EXAMPLE 3.

What is the compound Interest of £217 for a year, at £5 *per Cent. per Annum*, supposing the Interest payable quarterly?

217 × .05 = ¼) 10.85 — the In. for 1 year

To 2.7125 — the In. for 1st qur.

Add 217. — the 1st. princip.

219.7125 prin. for 2d. quar.

.05

¼) 10.985625

To 2.7464 — the Int. for the 2d, quarter.

Add 219.7125 — the prin for the 2d, quarter.

222.4589 principal for the 3d, quarter.

.05

¼) 11.122945

To 2.7807 — the Int. for the 3d, quarter.

Add 222.4589 — the prin. for the 3d, quarter.

225.2396 — the prin. for the 4th, quarter.

.05

¼) 11.26198

To 2.8154 — the Int. for the 4th qur.

Add 225.2396 — the prin. for the 4th qur.

From 228.055 — the amount

Dedt. 217. — the 1st, principal

Rem. 11.055 = £11 1*s* 1*d* the Answer

The foregoing methods of working Compound Interest (tho' generally taught in schools) being rather tedious, I shall therefore shew the learner a much shorter method by the help of the two following tables,

TABLE I.

Years	The Amount of £1 at Comp. Int. for years.			
	3½ p. Cent.	4 p. Cent.	4½ p. Cent.	5 p. Cent.
1	1.035	1.04	1.045	1.05
2	1.071225	1.0816	1.092025	1.1025
3	1.1087178	1.124864	1.1411661	1.157625
4	1.147523	1.1698586	1.1925186	1.2155063
5	1.1876863	1.2166529	1.2461816	1.2762816
6	1.2292553	1.265319	1.3022601	1.3400956
7	1.2722792	1.3159318	1.3608618	1.4071004
8	1.316809	1.3685691	1.4221006	1.4774554
9	1.3628973	1.4233118	1.4860251	1.5513282
10	1.4105987	1.4802443	1.5529694	1.6288946
11	1.4599697	1.5394541	1.622853	1.7103393
12	1.5110686	1.6010322	1.6958814	1.7958563
13	1.563956	1.6650735	1.7721961	1.8856491
14	1.6186945	1.7316764	1.8519449	1.9799316
15	1.6753488	1.8009435	1.9352824	2.0789282
16	1.733986	1.8729812	2.0223701	2.1828746
17	1.7946755	1.9479005	2.1133768	2.2920183
18	1.8574892	2.0258165	2.2084787	2.4066192
19	1.9225013	2.1068492	2.3078603	2.5269502
20	1.9897888	2.1911231	2.411714	2.6532977
21	2.0594314	2.2787681	2.5202411	2.7859626
22	2.1315115	2.3699188	2.633652	2.9252607
23	2.2061144	2.4647155	2.7521663	3.0715238
24	2.2833284	2.5633042	2.8760138	3.2251
25	2.3632449	2.6658363	3.0054344	3.3863549
26	2.4459585	2.7724697	3.1406709	3.5556727
27	2.5315671	2.8833685	3.2820095	3.7334563
28	2.6201719	2.9987033	3.4296999	3.9201291
29	2.7118779	3.1186514	3.5840364	4.1161356
30	2.8067937	3.2433975	3.7453181	4.3219424
31	2.9050315	3.3731334	3.9138575	4.5380396
32	3.0067077	3.5080588	4.0899811	4.7649416
33	3.1119425	3.6483812	4.2740303	5.0031887
34	3.2208605	3.7943165	4.46636[illegible]7	5.2533482

TABLE 2.

Days	The Amount of £1 at Comp. Int. for Days.			
	3½ *p. Cent.*	4 *p. Cent.*	4½ *p. Cent.*	5 *p. Cent.*
1	1.0000942	1.0001074	1.0001206	1.0001336
2	1.0001885	1.0002149	1.0002412	1.0002973
3	1.0002827	1.0003224	1.0003618	1.0004011
4	1.000377	1.0004299	1.0004824	1.0005348
5	1.0004713	1.0005374	1.0000031	1.0006685
6	1.0005656	1.0006449	1.0007238	1.0008023
7	1.00066	1.0007524	1.0008445	1.0009361
8	1.0007542	1.00086	1.0009652	1.0010699
9	1.0008486	1.0009075	1.0010859	1.0012037
10	1.0009429	1.0010751	1.0012066	1.0013376
20	1.0018867	1.0021512	1.0024148	1.002677
30	1.0028315	1.0032288	1.0036243	1.0040182
40	1.0037771	1.0043074	1.0048354	1.0053611
50	1.0047236	1.0053871	1.0060479	1.0067059
60	1.005671	1.006468	1.0072618	1.0080525
70	1.0066193	1.0075501	1.0084773	1.0094009
80	1.0075685	1.0086333	1.0096942	1.0107511
90	1.0085186	1.0097177	1.0109125	1.0121031
100	1.0094696	1.0108033	1.0121324	1.0134569
110	1.0104214	1.01189	1.0133537	1.0148125
120	1.0113742	1.0129779	1.0145765	1.0161699
130	1.0123279	1.0140670	1.0158007	1.0175291
140	1.0132825	1.0151572	1.0170265	1.0188902
150	1.0142379	1.0162487	1.0182537	1.0202531
160	1.0151943	1.0173412	1.0194824	1.0216178
170	1.0161516	1.018435	1.0207126	1.0229843
180	1.0171098	1.0195299	1.0219442	1.0243527
190	1.0180689	1.0206261	1.0231774	1.0257128
200	1.0190288	1.0217233	1.024412	1.0270949
210	1.0199897	1.0228218	1.0256481	1.0284687
220	1.0209315	1.0239215	1.0268858	1.0298444
230	1.0219142	1.0250223	1.0281249	1.0312219
240	1.0228778	1.0261243	1.0293655	1.0326013
250	1.0238424	1.0272275	1.0306076	1.0339825

The construction of *Table* 1st. is no more than involving the amount of £1 for a year, to the power of the number of years. Thus for 3 years 1.05 × 1.05 × 1.05 = 1.157625 as you'll find in the table under £5 *per Cent.*

Table 2d. is constructed by a continual multiplication of the amount of £1 for a day, (being the root of its amount for a year extracted to the 365th, power.)

The amount of £1 for a day at £5 *per Cent.* being 1.0001336 then 1.0001336×1.0001336×10001336= 1.0004011 the amount of £1 at the same rate Compound Interest for 3 days.

COROLLARIES.

Cor. 1. *When the* principal, time *and* rate *are given to find the* amount.——Multiply the amount of £1 found in the table, at the given rate and time, by the principal, and the product will be the answer.

Cor. 2. *When the* rate, time *and* amount *are given to find the* principal.—Divide the given amount, by the amount of £1 in the table at the given rate and time, and the quote will be the answer.

Cor. 3. *When the* amount, rate, *and* principal *are given to find the* time.—Divide the amount by the principal, the quote will be the amount of £1 at the given rate, which being found in one of the tables under that rate, will shew the time required.

Cor. 4. *When the* amount, time, *and* principal *are given to find the* rate.—Divide the amount by the principal, and the quote will be the amount of £1, which being found in the table even with the given time, will shew the rate required.

EXAM-

EXAMPLE 4.

At three pound ten, * come tell to me,
What th' 'mount of sixty pounds will be,
For twenty years, not more nor less,
Ingenious *Tyro* this express.

By *Cor*. 1 in the preceding *page*.

1.9897888	Tabular number against 20 years			
60	at $3\frac{1}{2}$ *per Cent.*			
	£	s	d	
Ans. 119.387328	= 119	7	$8\frac{1}{4}$	the amt. required.

EXAMPLE 5.

To what will £463 amount to, at L4 *per Cent. per Annum*, for 220 days, Compound Interest?

1.0239215	= Tab. number against 220 days		
460	at 4 *per Cent.*		
614352900			
40956860			
	£	s	d
Amt. 471.00389	= 471	-	$-\frac{3}{4}$

SCHOLIUM.

If you want to know the amount for a greater number of years or days than those in the tables.— Divide the given time into such parts as are in the tables, and the amounts answering thereto multiplied one into another continually, will produce the amount of *l* 1 for the given time, with which proceed as directed in *Cor*. 1 in the preceding *page*.

* *Per Cent.—per Annum.*

EXAM-

EXAMPLE 6.

What is the amount of £50 10*s* for 64 years at £5 *per Cent. per Annum*, Compound Interest?

First 4.3219424	the am. of £1 for	30	years at £5 *per C.* as *per* table
and 5.2533482		34	

Then per Scholium 4.3219424 multiplied (according to the *contraction* in *page* 287) by 5.2533482 produces 22.704669 the amount of £1 for 64 years at £5 *per Cent.* which amount being multiplied by the given principal *viz.* £50.5 will produce 1146.5857845 = £1146 11*s* 8*d* ½ the Answer.

EXAMPLE 7.

What will £140 amount to in 167 days at £3 10*s* *per Cent. per Annum*, Compound Interest?

First 1.0151943	the am. of £1 for	160	Days at £3 ½ *per Cent.*
and 1.00066		7	(as *per* table.

Then 1.0151943 multiplied by 1.00066 produces 1.0158643 &c. the amount of £1 for 167 days at £3 ½ *per Cent.* which amount being multiplied by the principal £140, will produce 142.221002 = £142 4*s* 5*d* the Answer.

EXAMPLE 8.

What is the present worth of £100 10*s* 10*d* ½ due 12 years hence, at £4 ½ *per Cent. per Annum*, Compound Interest?

By *Cor.* 2, *page* 344.—Divide the given amount £100.54375 (according to the *contraction* in *page* 292) by 1.6958814 *viz.* the amount of £1 for 12 years, at £4 ½ *per Cent.* as *per* table, and the quotient will be 59.287017 = £59 5*s* 8*d* ¾ the Answer.

EXAM-

EXAMPLE 9.

A grave old Batchelor of late,
  Had left him as appears,
A Legacy * by honeſt *Kate*,
  T' receive in ſeven years, †
And being aged as we find
  Juſt three ſcore years and one,
To ſell the ſum, he was inclin'd
  Unto his neighbour *John*;
What was the preſent worth I ſay,
  Of this ſaid Legacy?
That *John* muſt to the old man pay ‡
  Come tell me inſtantly.

* of £800

† and 89 days

$$\begin{array}{l} \textit{First} - \\ \text{and} \end{array} \begin{array}{l} 1.4071004 \\ \left\{ \begin{array}{l} 1.0107511 \\ 1.0012037 \end{array} \right. \end{array} \Bigg\} \text{amt. of } \pounds 1 \text{ for} \left\{ \begin{array}{l} 7 \text{ years} \\ \left. \begin{array}{l} 80 \\ 9 \end{array} \right\} \text{days} \end{array} \right\} \text{at } \pounds 5 \textit{ per Cent.} \text{ as } (\textit{per} \text{ table.}$$

Then per Scholium page 345, 1.4071004 multiplied (according to the *contraction* in *page* 287) by 1.0107511 produces 1.4222283 (the amount of £1 for 7 years and 80 days at £5 *per Cent.*) which being multiplied (according to the ſaid *contraction*) by 1.0012037 produces 1.4239402 (the amount of £1 for the given time and rate) by which dividing the given legacy or amount, *viz.* £800 quotes 561.821 = £561 16*s* 5*d* the Anſwer.

EXAMPLE 10.

In what time will £300 amount to £373 17*s* 1*d* at £4½ *per Cent. per Annum.* Compound Intereſt?

$$3|00)\ 3|73.85416$$

By *Cor.* 3 *page* 344.

1.2461805 the amount of £1 for the required time, which amount being found under £4½ *per Cent.* in the table ſhews 5 years to be the time required.

---

‡ Allowing 5 *per Cent. per Annum*, Compd. Intereſt.

EXAM-

EXAMPLE 11.

How long must £1000 be out at Compound Interest before it amounts to £1400 5*s* 6*d* at £4 *per Cent. per Annum?*

1000) 1400.275 (1.400275 the amount of £1 for the required time, which amount not being in either of the two tables, therefore seek the next less thereto which you will find in table 1 under £4 *per Cent.* to be 1.3685691 *viz.* the amount of £1 for 8 years at the given rate, by which amount divide the number sought, *viz.* 1.400275 (according to the *contraction* in *page* 292) and the quotient will be 1.0231672, the nearest less number to which in the second table under the same rate is 1.0228218 answering to 210 days, then divide 1.0231672 (according to the said *contraction*) by 1.0228218 (the amount of £1 for 210 days at the given rate) and the quotient will be 1.0003377 which answers in the table *nearly* to 3 days, whence the answer is 8 years and 213 days.

EXAMPLE 12.

At what rate *per Cent. per Annum* Compound Interest will £60 amount to £119 7*s* 9*d* in 20 years?

60) 119.3875

By *Cor.* 4 *page* 344.

1.9897916 the amount of £1 for 20 years, which (in the table) corresponds with £3 ½ *per cent* the answer.

SCHOLIUM.

Having now given sufficient examples to explain the use and excellence of the two preceding tables, I shall in the next place give a few examples relating to *Freehold* or *Real Estates*, and then proceed to *Rebate or Discount.*

EXAM-

EXAMPLE 13.

Suppose a Gentleman had £6000 in ready money, and was desirous to lay it out in the purchase of a Freehold Estate, and to be allowed £4 *per Cent.* for his money Compound Interest. What must be the annual Rent of such an Estate or purchase?

	£		£		£		£	
As	100	:	4	::	6000	:	240	the Answer.

EXAMPLE 14.

Suppose a Freehold Estate of £240 *per Annum* was to be sold, and the purchaser to be allowed £4 *per Cent.* Compound Interest. What wou'd be the purchase money and how many years purchase must the Estate be sold for?

	£		£		£		£	
First As	4	:	100	::	240	:	6000	the purchase money

Then As £240 : year 1 :: £6000 : 25 the N°. of years purchase

Or (without knowing the purchase money or yearly Rent) As 4 : 1 :: 100 : 25

by which multiply the annual Rent *viz.* £240, and the product will be £6000 the purchase money, as before.

EXAMPLE 15.

Suppose a Gentleman bought a Freehold Estate of £240 *per Annum* for £6000, what rate of Compound Interest was he allow'd?

	£		£		£		£	
As	6000	:	240	::	100	:	4	the Answer.

Or (without knowing the annual Rent or purchase money) As 25 (the number of years purchase found in the preceding example) : £100 :: 1 year : £4 the rate the same as in the preceding *page*.

Note. When Freehold Estates are to be sold or purchased in reversion, the following examples will sufficiently determine an explanation.

Example 16.

Suppose the reversion of a Freehold Estate of £240 *per Annum* to commence 10 years hence was to be sold, what is it worth allowing the purchaser £4 *per Cent*. Compound Interest for his money?

First (by example 14 *page* 349) As £4 : £100 :: £240 : £6000. *Then* (*per Cor.* 2 *page* 344) divide £6000 (according to the *contraction* in *page* 292) by 1.4802443 *viz.* the amount of £1 for 10 years at £4 *per Cent.* (as *per* table) and the quotient will be 4053.38497 &c = £4053 7*s* 8*d* $\frac{1}{4}$ the answer.

Example 17.

If the reversion of a Freehold Estate to commence 10 years hence, be sold for £4053 7*s* 8*d* $\frac{1}{4}$ and the purchaser be allow'd £4 *per Cent*. Compound Interest for his money, what is the yearly Rent of the Estate?

First (by *Cor.* 1 *page* 344) 1.4802443 *viz.* the amount of £1 for 10 years at £4 *per Cent.* as *per* table, multiplied (according to the *contraction* in *page* 287) by 4053.38497 &c. produces £6000. *Then* (*per* example 13 *page* 349) As £100 : £4 :: £6000 : £240 the annual Rent required.

REBATE

REBATE, *or* DISCOUNT.

REBATE discovers to your view,
The diff'rence 'twixt a sum that's due,
At any certain time to come,
And th' present worth of such a sum
Or debt, that shall contracted be;
As by the following rule you'll see.

RULE.

Th' amount of just one hundred pound,
For th' time, and rate, must first be found;
Then as that sum's to th' int'rest* net,
So is the given sum, or debt,
To th' present worth, or Discount true,
Of th' given sum that shall be due.

* or £100

EXAMPLE I.

What is the Discount of £1000 for 10 months, at £4 *per Cent. per Annnm?*

Mo.		£			
6	$\frac{1}{2}$	4. Rate *per Cent.*			
4	$\frac{1}{3}$	—			
To		2.	the Int. of £100 at the given rate for	6	Months
Add		1.3333		4	
And to		3.3333		10	
Add		100. Principal			

	£	£	£	£	£ s d
As	£103.3333 :	3.3333 ::	1000 :	32.258 =	32 5 1¾

(the Answer.

EXAMPLE 2.

What is the present worth of a £40 note, due 15 months hence, Discount at £5 *per Cent. per Annum.*

$$\begin{array}{rl} & £ \\ \frac{1}{4} & 5 \\ & 1.25 \\ \text{To} & 6.25 \end{array} \left.\vphantom{\begin{array}{c}1\\1\\1\\1\end{array}}\right\} \text{the Interest of } \overset{£}{100} \text{ for} \left\{\begin{array}{c} 12 \\ 3 \\ 15 \end{array}\right\} \text{Mths.}$$

Add 100. Principal

As £106.25 : 100 :: 40 : 37.647 &c = £37 12s 11d $\frac{1}{4}$ (the Answer.

Or, by *Cor.* 2. in Simple Interest, *page* 331.

First 1.25 × .05 + 1 = 1.0625 *Then* divide £40 by 1.0625, and the quotient will be 37.647 &c. = £37 12s 11d $\frac{1}{4}$ the Answer, the same as above.

EXAMPLE 3.

Admit I pay £37 12s 11d $\frac{1}{4}$ for a Note due 15 months hence, and am allow'd £5 *per Cent.* Discount. *Quere* the value of the Note?

The amount of the present worth is the sum to be discounted, therefore £37 12s 11d $\frac{1}{4}$ = 37.646875 × .05 × 1.25 = 2.3529 &c. the Interest of the present worth, or the Rebate of the value of the Note, to which Interest or Rebate add 37.646875 the present worth, and the sum will be 39.999 &c. = £40 nearly the value required.

EXAM-

EXAMPLE 4.

Suppose I had a Legacy
  Of forty pounds in cash,
Due at a certain time to come,
  And sell to *Toby Flash* — £ s d
The same, for what is here subjoin'd* — *37 12 11¼
  Th' executor t' allow† — †£5 *per cent*
When must the Legacy be paid
  Without Rebate tell now?

Solution by *Cor.* 3 in Simple Interest *page* 331.

	£	s	d		£	
From	40	—	—	=	40.	Legacy
Ded.	37	12	11¼	=	37.646875	Pr. worth
37.6468&c. × .05 = ~~1.88234 &c.~~				)	2.353125	Rebate

Quote 1.25 = 1¼ Year, or 15 Months the Answer.

EXAMPLE 5.

Admit a Note or Legacy of £40 payable at 15 months hence, be sold for £37 12s 11d¼ present payment. At what rate *per Cent*, was it sold for?

Solution by *Cor.* 4 in Simple Interest *page* 332.

First £37 12s 11d¼ (the present worth) = 37.646875 which deduct from £40 (the note or legacy) and the remainder will be 2.353125 the Rebate. *Then* divide 2.353125 by 47.0585 &c. *viz.* the product arising from 37.646 &c. being multiplied by 1.25 (the time) and the quotient will be £.05 the ratio = £5. the rate required.

PROMISCUOUS QUESTIONS.

Question 1 by Mr. *James Hardy.*

What is the present worth of (or how much money paid immediately will satisfy for) £696 3*s* 9*d* due 3 years 6 months and 73 days hence; allowing Discount at £5 *per Cent. per Annum?*

£
73*dys* | 1/5 | 5
3
mo | 1/6 | 15
2.5
1.
To 18.5 } the Inter. of £100 at the giv. rate for { ys. ms. dys.: 3 — —; — 6 —; — — 73; total 3 6 73
Add 100 Prin.

	£		£		£	s	d		
As . 118.5 :	100	::	696.1875 :		587	10	—	Ans.	pr. worth
	18.5				108	13	9		Rebate
				Proof	£696	3	9		

Or, by *Cor.* 2 in Simple Interest *page* 331.

First, 3 years, 6 months, and 73 days = 3.7 years *Then* 3.7 × .05 + 1 = 1.185 by which divide £696 3*s* 9*d* = £696.1875 and the quotient will be £587.5 = £587 10*s* the present worth, the same as above.

Question 2 by Mr. *Charles Hutton.*

What is the present worth of £120 payable as follows, *viz.* £50 at 3 months, £50 at 5 months, and the rest at 8 months, Discount at £6 *per Cent per Annum?*

Solution

Solution by Cor. 2 in Simple Interest *page* 331.

yrs.	yrs.	yrs.
3 mo. = .25	5 mo = .4166	8 mo. = .6666.
.06	.06	.06
Prod. .015	Prod. .025	Prod. .04

The proper divisors being found, by adding 1 to each of the above products, proceed thus

1.015)50.00(49.261

1.025)50.00(48.7804

1.04)20.00(19.2307

	£	s	d	
£117.2721 =	117	5	5¼	Answer.

EQUATION of PAYMENTS.

OBSERVE me *Tyro*, now you'll see
Debtor and creditor agree,
When sev'ral debts are to be paid,
At diff'rent times, but after made
An Equal Payment of the whole,
Without sustaining loss—*per rule*.

RULE.

Each Payment multiply I say,
By th' time its due, and then you may
Divide the sum of th' products by
The sum of th' Payments, you'll espy
Th' equated time, the whole's to be
Paid without loss, as here you'll see.

EXAM-

EXAMPLE 1.

Simon owes *Andrew* £80 which was to be paid £40 at 3 months and £40 at 7 months, but they agree to reduce the whole to one Payment. *Quere* the equated time?

£ mo. £
$40 \times 3 = 120$
$40 \times 7 = 280$

8|0)40|0

Ans. 5 months.

EXAMPLE 2.

Hugh is indebted to *Cornelius* £1000 which is to be discharged thus, *viz.* £200 present, £600 at 5 years end, and the remainder at the end of 8 years. *Quere* the equated time of Payment?

£ yrs. £
$$\left.\begin{matrix}600\\200\end{matrix}\right\}\times\left\{\begin{matrix}5\\8\end{matrix}\right\}=\left\{\begin{matrix}3000\\1600\end{matrix}\right.$$

1000)4600

Ans. 4.6 years

EXAMPLE 3.

A Gentleman being desirous of making a Purchase, borrows of a friend £460 which by agreement was to be repaid at the end of 6 months, but the Gentleman finding he had more cash than was needful for the abovementioned purpose, would remit back to his friend £160 provided he would allow him a longer time for the Payment of the remainder, which being agreed upon, the time of Payment is required?

	£	£
From	460	460
Take	160	6
	3|00)	276|0/0

Answer 9.2 months.

EXAMPLE

EXAMPLE 4.

An honeſt Man agrees to pay
One hundred Pounds a certain way,
One fourth in hand, and as we find,
The ſame each three months to his mind
Until the whole's diſcharged fair,
What is th' equated time ? declare.

$$\begin{array}{l} \text{£} \\ 25 \end{array} \times \left\{ \begin{array}{c} \text{mo.} \\ 3 \\ 6 \\ 9 \end{array} \right\} = \left\{ \begin{array}{r} \text{£} \\ 75 \\ 150 \\ 225 \end{array} \right.$$

$$100)450$$

Anſ. $4.5 = 4\frac{1}{2}$ months

COROLLARY.

When Rebate *is to be made at ſo much per Cent. per Annum.*—Find the preſent worth of each Payment for its reſpective time, the ſum of which preſent worths deduct from the whole ſum or debt and the remainder will be the Rebate or Diſcount thereof, and then by proceeding according to *Cor.* 3 in Simple Intereſt *page* 331, the *true equated time* will be eaſily known.

EXAMPLE 5.

Job owes *Moſes* £200 which by agreement was to be paid as follows, *viz.* £80 at 4 months, £70 at 6 months, and the remaining £50 at the end of 9 months, but

but they agree to have but one Payment of the whole. *Quere* the true equated time, Rebate being made at £4 *per Cent. per Annum?*

The present worth of	£	at £4 *per Cent.* due		Mths. hence will be easily found by the *rule* in p. 351 or by *Cor.* 2 p. 331 to be	£
	80		4		78.9473
	70		6		68.6274
	50		9		48.5436

The present worth of £200, 196.1183
(payable as above

£
From 200.
Take 196.1183

$196.1183 \times .04 = 7.844732)$ 3.8817 Rebate

Quote .4948 Parts of a year $=$ 5 months 3 weeks and 5 days the Answer.

SCHOLIUM.

I might in this place introduce various other rules by different authors (who have endeavoured to make improvements on this common method, as given by *Cocker*,) some of which are Mr. *John Kersey*, Mr. *Hatton*, Sir *Samuel Moreland*, Mr. *Ward*, Mr. *Malcolm*, &c. but must beg to be excused as room will not permit them, and the common method being more adapted to practice, and what is generally taught in schools, and is near enough the truth in common affairs. Mr. *Malcolm*'s rule is the only true one, but very operose when the payments are to be made at different times.—This Gentleman, after putting *d* for the

the first Payment, t the distance of its term of Payment; D the last payable Debt, and T the distance of its Term, and r the rate of one year's Interest for £1, and $x =$ the distance of the equated Time; proceeds by an *algebraic* way of reasoning founded on the principles of *Simple Interest*, brings out $T + t + \frac{D + d}{dr}$ which he calls the first Number found, and $\frac{DT + dt}{dr} + Tt$ the second Number found, which two Numbers are called a and s, then (he says)

$$ax - x^2 = s, \text{ whence } x = \frac{a \pm \sqrt{a^2 - 4s}}{2}$$ the present rule or equated time for any two Payments.

The ingenious Mr. *Hutton* makes mention of the above rule in *page* 88 of his Arithmetic, but his examples are all worked by the common method.

PROMISCUOUS QUESTIONS.

Question 1. by Mr. *John Hampson* at *Bedford-Mill*, near *Leigh*, *Lancashire*.

From *Palladium*, 1753.

My Son having gone a considerable time to *Leigh* School at 1*s* 6*d* by the quarter, to read *English*, which commenced on the 14th of *January*, 1752: I agreeing with Mr. *Henry Arrowsmith*, the Master of the School, to pay him 4*s* by the quarter, for his writing my Son a copy or two each day besides; but he not beginning to write 'till the 19th, I would have you

you (*Palladium Arithmeticians*) shew the exact time when 4*s* become due to the Master?

First to 30 the Days in the Month, add 5 the number of Days from *January* 14th, to the time he began to write, and the Sum will be 35, *Then per* Rule *p.* 355.

$$18 \times 30 = 540$$
$$35 \times 30 = 1050$$

s *d* ———

$4 = 48)\ 1590(33\frac{6}{48} = 33\frac{1}{8}$ from which deduct 30 and there will remain $3\frac{1}{8}$ Days the exact time to be added to the quarter.

Note. It matters not whether you take 29, 30, or 31 days to a month, the Answer is the same, as Mr. *Hampson* justly remarks.

Question 2. by the late *Thomas Dod*, Esq; of *Edge*, near *Malpas*, *Cheshire*.

Ladies Diary, 1720.

At *Michaelmas*, seventeen hundred nineteen,
My writings will shew, (which are yet to be seen)
That to me were three hundred and twenty pounds due,
And half of that sum besides forty two *viz.* £202.
Just five years after I then might demand, (hand;
But wou'd fain have the whole somewhat sooner in
I agree to rebate for the latter sum, too
The same rate (simple Interest) our statutes allow,
But then I expect some use will accrue
From my sixteen score pounds, that last year were due.
Now to know on what day I shall be very fond,
To receive my five hundred and twenty-two pound?

Solution, by Mr. *Malcolm*'s Rule, given in this Treatise, in the preceding *page*.

First, to £320 add £202 and divide the Sum by £16 (a year's interest of the £320) and the quotient will be 32.625 which add to 5 and the sum will be 37.625 which (as the £320 was to be paid down) is the

the first number. *Secondly*, multiply 202 by 5 and divide the product by 16 and the quotient will be 63.125 the second number. *Then*, from 1415.640625 the square of 37.625 the first number, deduct 252.5 *viz.* 4 times 63.125 the second number, and the remainder will be 1163.140625, the square root whereof is 34.1048 which deduct from 37.625 (the first number) and the remainder will be 3.5202, one half of which is 1.7601 = 1 year and 277 days the true equated time, and which answers to *July* 4th, 1721.

SINGLE FELLOWSHIP.

By Fellowship, you'll quickly find,
How Stocks in partnership combin'd
Are calculated just and true,
And each receive his proper due.

RULE

Say, by the *Golden Rule of Three*,
As the whole Stock, whate'er it be,
Is to each partner's loss or gain,
So is his Stock 'tis very plain;
To his partic'lar share you'll find
Of loss or gain in comp'ny join'd.

EXAMPLE 1.

Two partners, *John* and *Thomas*, make a stock of £240; *John* puts in £110, and *Thomas* £130, by which they gain in trade £80. What is each man's share?

$$\begin{array}{lll} & £ & \\ \textit{First} \text{ to} & 110 & \textit{John's} \\ \text{Add} & \underline{130} & \textit{Thomas's} \end{array}\Big\}\text{ Stock}$$

$$\textit{Then} \text{ As } \overset{}{240} : \overset{£}{80} :: \left\{\begin{array}{r} \overset{£}{110} \\ 130 \end{array}\right\} : \left\{\begin{array}{rrr} \overset{£}{36} & \overset{s}{13} & \overset{d}{4} \\ 43 & 6 & 8 \end{array}\right. \begin{array}{l} \textit{John's} \\ \textit{Thomas's} \end{array}\Big\} \text{ share of the gain.}$$

Proof £80

EXAMPLE 2.

Two merchants *A* and *B* make a stock, *A* puts in £250 and *B* £150 they trade and gain £300 which by agreement is to be so divided that *A* may have £6 *per Cent.* and *B* £4½. What must each have of the gain?

$$\text{The Int. of} \left\{\begin{array}{rl} \overset{£}{250} & \textit{A's} \\ 150 & \textit{B's} \end{array}\right\} \text{stock at} \left\{\begin{array}{l} 6 \\ 4\frac{1}{2} \end{array}\right\} \textit{per C.} \text{ is} \left\{\begin{array}{rr} \overset{£}{15} & \overset{s}{—} \\ 6 & 15 \end{array}\right.$$

Sum 21 15

$$\text{As } \overset{£}{21}\ \overset{s}{15} : \overset{£}{300} :: \left\{\begin{array}{rr} \overset{£}{15} & \overset{s}{—} \\ 6 & 15 \end{array}\right\} : \left\{\begin{array}{rrrl} \overset{£}{206} & \overset{s}{17} & \overset{d}{11} & —\frac{20}{29} \ \textit{A's} \\ 93 & 2 & — & \frac{3}{4}\ \frac{9}{29} \ \textit{B's} \end{array}\right\} \text{share}$$

Proof £300

COROL-

COROLLARY.

When many partners are concerned the operation will be sooner done than by the common method, by finding a pound rate, *viz.* by dividing the whole loss or gain by the whole stock, and the quotient will be a common multiplier or pound rate, by which multiply each partner's share of the stock, and the product will be his share of the loss or gain.

EXAMPLE 3.

Suppose three Cheesemongers *A B* and *C* had 180 tons of cheese on board a ship at Sea, *A*'s was 84 tons, *B*'s 61, and *C*'s 35, but unfortunately being distressed in a storm, they were obliged (in order to lighten the ship) to cast $\frac{3}{5}$ of the loading overboard. What does each man sustain of the loss?

First, $\frac{3}{5}$ of 180 = 108 the whole loss. *Then*, (by the abovementioned *Cor.* divide 108 by 180 and the quotient will be .6 for a common multiplier.

$$\left.\begin{matrix}84\\61\\35\end{matrix}\right\}\times .6=\left\{\begin{matrix}50.4\\36.6\\21\end{matrix}\right\}\text{Tons}=\left\{\begin{array}{lll}\text{T.} & \text{C.} & \\ 50 & 8 & A\text{'s}\\ 36 & 12 & B\text{'s}\\ 21 & - & C\text{'s}\\ \hline \text{Proof } 108 & - & \text{whole}\end{array}\right\}\text{Loss.}$$

EXAMPLE 4.

In honour of *Crispin* the Cordwainers they
Prepared a Feast to be jovial and gay,
Six Tanners, eight Curriers at first took their place,
Sixteen Cordwainers next, all with reg'lar grace,
Then the Coblers next, who were twenty and one,
At table sat down with their host merry *John*:
When dinner was over full bumpers did pass,
Some drank a full noggin and some a wide glass,

Caroufing and finging they paft the long day,
No fons of great *Bacchus* more jovial than they.
At laft for the reck'ning the Tanners did call,
Whilft fome of the Coblers did nothing but bawl
For old *Hock*, or *Stingo*—the Landlord came in
With his fcores round a trencher—to work did begin,
And found that ten pounds was the fhot to defray,
Then tell to me *Tyro* what each had to pay,
When the Tanners and th' others agreed very true,
In proportion to pay, as five, four, three and two ?

It is evident by the queftion that as oft as each Tanner paid 5*s*, the others paid 4*s*, 3*s*, and 2*s* a piece, which fum multiply by the number of each trade, or occupation.

$$\left.\begin{matrix}6\\8\\16\\21\end{matrix}\right\}\times\left\{\begin{matrix}s\\5\\4\\3\\2\end{matrix}\right\}=\left\{\begin{matrix}s\\30\\32\\48\\42\\\hline 152\end{matrix}\right\}=\left\{\begin{matrix}£\\1.5\\1.6\\2.4\\2.1\\\hline 7.6\end{matrix}\right.$$

Per Cor. in the preceding *page.*
7.6)10.0(1.31578
Com. Multiplier.

$$1.31578\times\left\{\begin{matrix}£\\1.5\\1.6\\2.4\\2.1\end{matrix}\right\}=\left\{\begin{matrix}£\\1.97367\\2.105248\\3.157872\\2.763138\end{matrix}\right\}\text{the}\left\{\begin{matrix}6\text{ Tanners}\\8\text{ Curriers}\\16\text{ Cordwainers}\\21\text{ Coblers}\end{matrix}\right\}\text{Share.}$$

$$\left.\begin{matrix}£ & £\\6)1.97367 & (.328945\\8)2.105248 & (.263156\\16)3.157872 & (.197367\\21)2.763138 & (.131578\end{matrix}\right\}=\left\{\begin{matrix}s & d\\6 & 6\frac{3}{4}+\\5 & 3+\\3 & 11\frac{1}{4}+\\2 & 7\frac{1}{2}+\end{matrix}\right\}\text{each}\left\{\begin{matrix}\text{Tanner's}\\\text{Currier's}\\\text{Cordwainer's}\\\text{Cobler's}\end{matrix}\right\}\text{Share.}$$

EXAM-

EXAMPLE 5.

An Usurer dying, left the whole of his Fortune to be disposed of in the following manner: To *A* $\frac{2}{5}$, to *B* $\frac{3}{10}$, to *C* $\frac{1}{8}$, to *D* $\frac{1}{20}$, to *E* $\frac{1}{40}$, and to *F* $\frac{1}{50}$, and the remainder which was £800 to *C* (over and above his $\frac{1}{8}$). What was the whole Sum left, and each one's Share thereof?

$$\left.\begin{array}{c}\frac{2}{5}\\ \frac{3}{10}\\ \frac{1}{8}\\ \frac{1}{20}\\ \frac{1}{40}\\ \frac{1}{50}\end{array}\right\}=\left\{\begin{array}{r}.4\\ .3\\ .125\\ .05\\ .025\\ .02\\ \hline \text{Sum } .92\end{array}\right\}\text{Parts of £1.}$$

$$\begin{array}{lr} & £\\ \text{From} & 1.\\ \text{Take} & .92\\ \hline & .08)\ 800.00\ \text{£}\\ \hline & £10000 \text{ the whole Sum left.}\end{array}$$

$$\begin{array}{c}\text{£10000}\\ \text{mult. by}\end{array}\left\{\begin{array}{l}.4\\ .3\\ .125\end{array}\right\}=\left\{\begin{array}{rl}4000 & A\text{'s}\\ 3000 & B\text{'s}\\ 1250 & \multirow{2}{*}{C's}\\ 800 & \end{array}\right.$$

$$\begin{array}{c}\text{£10000}\\ \text{mult. by}\end{array}\left\{\begin{array}{l}.05\\ .025\\ .02\end{array}\right\}=\left\{\begin{array}{rl}500 & D\text{'s}\\ 250 & E\text{'s}\\ 200 & F\text{'s}\\ \hline \text{Proof } £10000 & \end{array}\right\}\text{Share.}$$

Or thus,

The shares or fractions in this example, *viz.* $\frac{2}{5}$, $\frac{3}{10}$, $\frac{1}{8}$, $\frac{1}{20}$, $\frac{1}{40}$, and $\frac{1}{50}$, reduced to a common denominator (by the *note* to *case* 9. *page* 251) become $\frac{80}{200}$, $\frac{60}{200}$, $\frac{25}{200}$, $\frac{10}{200}$, $\frac{5}{200}$, and $\frac{4}{200}$, whereby the whole Fortune is divided into 200 equal parts, whereof *A*'s is 80, *B*'s 60, *C*'s 25, (exclusive of his £800) *D*'s 10, *E*'s 5, and *F*'s 4, which being added together and the Sum, *viz.* $\frac{184}{200}$ deducted from $\frac{200}{200}$ or the whole, leaves $\frac{16}{200}$, which is equal (by the question) to £800, consequently $\frac{1}{200}$ will

 be

be $\frac{800}{16}$=£50 which multiplied severally by 200, 80, 60, 25, 10, 5 and 4, and adding the £800 to the product had by multiplying by 25, will produce the whole Sum left, and each one's respective Share thereof, the same as in the preceding *page*.

Note. The above Question I propos'd in *Owen*'s Magazine for *December* 1764, from whence Mr. *Birks* copied it into his Arithmetic, *page* 594.

Example 6.

A *Miser* left his servant *Joe*,
  One hundredth of his store,
Which made the rustic's bosom glow,
  When counting of it o'er.
Then with one twentieth of his chink,
  To landlord *Belch* he goes,
And with a *Tinker* sits to drink,
  And his dear blooming *Rose*.
He lent the *Tinker* from this Sum,
  Two tenths, it was no more,
Three fifths he paid the Tapster *Tom*,
  Before he went on score;
One fortieth gave a Fidler *plus*,
  To play a merry tune,
Three sixtieths *Nan* to have a buss,
  At four i'th' afternoon.
Then half a crown he gave his *Fair*,
  To pay for cakes and spice,
Who dainty cordials does prepare,
  She being so very nice.
Three eightieths of his legacy,
  He left with *Belch* on score;
So *Tyro* now display your art,
  And ev'ry Sum explore?

First

First $\frac{2}{10}=\frac{1}{5}$, and $\frac{3}{60}=\frac{1}{20}$ *Then* the fractions $\frac{1}{5}$, $\frac{3}{5}$, $\frac{1}{40}$ and $\frac{1}{20}$ added together make $\frac{7}{8}$ which by the question is equivalent to all the money *Joe* took with him except the half crown he gave his *Fair*, therefore it is very plain that half a crown must be the remaining $\frac{1}{8}$, consequently 8 half crowns $=$ £1 was the money he took with him, $\frac{2}{10}$ or $\frac{1}{5}$ whereof $=$ 4*s* he lent the *Tinker*, $\frac{3}{5}=$ 12*s* he paid the *Tapster*, $\frac{1}{40}=$ 6*d* he gave the *Fidler*, and $\frac{3}{60}$ or $\frac{1}{20}=$ 1*s* he gave to *Nan*, which several Sums added to the half crown he gave his *Fair* make £1 (as before) which being the $\frac{1}{20}$ of his Legacy, therefore the whole Legacy must be £20, $\frac{3}{80}$ of which $=$ 15*s* he left on score, and the whole Legacy being $\frac{1}{100}$ of the *Miser*'s Store (as *per* question) therefore $20\times100=$ £2000 was the *Miser*'s whole Estate.

PROMISCUOUS QUESTIONS.

Question 1. by Mr. *Jeake*.

It is proposed to divide £300 among 3 persons so that *A* gets £6 more than $\frac{1}{2}$, *B* £12 more than $\frac{1}{3}$, and *C* £8 less than $\frac{2}{3}$. What is the equal Share of each?

$$\begin{array}{lll} & & £ \\ & \text{To} & 150 \\ \text{and} & \left\{\begin{array}{l}\text{to}\\ \text{from}\end{array}\right. & \begin{array}{r}100\\ 200\end{array} \end{array} \left.\vphantom{\begin{array}{l}a\\a\\a\end{array}}\right\} \text{the} \left\{\begin{array}{c}\frac{1}{2}\\ \frac{1}{3}\\ \frac{2}{3}\end{array}\right\} \text{of £300} \left\{\begin{array}{lr}\text{add} & 6\\ \text{add} & 12\\ \text{take} & 8\end{array}\right\} \text{and the} \left\{\begin{array}{l}\text{Sum}\\ \text{Sum}\\ \text{Rem.}\end{array}\right\} \text{will be} \left\{\begin{array}{r}156\\ 112\\ 192\end{array}\right.$$

Total £460 but

the Sum propos'd to be divided is only £300 therefore

$$\text{As } \overset{£}{460} : \overset{£}{300} :: \left\{\begin{array}{r}156\\ 112\\ 192\end{array}\right\} : \left\{\begin{array}{rrrl} £ & s & d & \\ 101 & 14 & 9\frac{1}{4}\frac{13}{23} & A\text{'s}\\ 73 & 4 & 10\frac{1}{4}\frac{17}{23} & B\text{'s}\\ 125 & — & 4—\frac{16}{23} & C\text{'s}\end{array}\right\} \text{Share.}$$

Proof £300 — —

Ques-

Question 2.

From the Town and Country Magazine for *April* 1769.

Five Weavers, four Taylors, and three Millers, drank to the value of £5 which they agreed to pay in the following manner, *viz.* $\frac{2}{5}$ of what the Weavers paid should be equal to $\frac{7}{8}$ of what the Taylors paid, and $\frac{5}{6}$ of what the Taylors paid should be equal to $\frac{3}{4}$ of what the Millers paid. *Quere*, what did the men of each Trade pay?

$$\text{Suppose } \pounds 1 \text{ to} \left.\begin{matrix} \\ \\ \end{matrix}\right\} \text{be the} \left\{\begin{matrix}\text{Weavers}\\ \text{Taylors}\\ \text{Millers}\end{matrix}\right\} \text{Share.}$$

$$\text{then (per Qu.) } \begin{matrix}\pounds\frac{2}{5}\\ \text{and } \frac{5}{6} \text{ of } \frac{16}{35}\end{matrix} \Big\} \text{divided by} \left\{\begin{matrix}\frac{7}{8}\\ \frac{3}{4}\end{matrix}\right\} = \left\{\begin{matrix}\frac{16}{35}\\ \frac{32}{63}\end{matrix}\right\} \text{will}$$

The sum of which shares is $\pounds 1\frac{304}{315} = \frac{619}{315}$ but the Sum spent was £5, therefore

$$\text{As } \pounds\frac{619}{315} : \pounds 5 :: \left\{\begin{matrix}\pounds\\ 1\\ \frac{16}{35}\\ \frac{32}{63}\end{matrix}\right\} : \left\{\begin{matrix}\pounds & s & d & \\ 2 & 10 & 10\frac{1}{2} & \frac{402}{619}\\ 1 & 3 & 3 & \frac{396}{619}\\ 1 & 5 & 10 & \frac{440}{619}\end{matrix}\right\} \text{the} \left\{\begin{matrix}\text{Weavers}\\ \text{Taylors}\\ \text{Millers}\end{matrix}\right\} \text{true Share.}$$

Proof £5 — — the Sum spent.

Question 3. by Mr. *Richard Car.*

There is in a Cathedral Church, 20 Canons and 30 Vicars, and they spend in a year £2600, but every Canon must have 5 times as much as a Vicar. How much is each man's yearly Income?

First, $20 \times 5 = 100$, and $100 + 30 = 130$ *Then*

$$\text{As } \pounds 130 : \pounds 2600 :: \left\{\begin{matrix}\pounds 100\\ 30\end{matrix}\right\} : \left\{\begin{matrix}\pounds 2000\\ 600\end{matrix}\right\} \text{for the} \left\{\begin{matrix}20 \text{ Canons}\\ 30 \text{ Vicars}\end{matrix}\right.$$

$$\left.\begin{matrix}\pounds\;\;\;\;\;\pounds\\ 20)2000(100\\ 30)\;600(\;20\end{matrix}\right\} \text{the yearly income of each} \left\{\begin{matrix}\text{Canon}\\ \text{Vicar}\end{matrix}\right.$$

DOU-

DOUBLE FELLOWSHIP.

THIS Rule determines very fair,
At diff'rent times each partner's Share.
How each one finds his loss or gain,
As underneath I shall explain.

RULE.

Each partner's Stock first multiply
By th' time he does the same employ;
Then as th' Sum of these products be,
To the whole gain or loss you'll see,
So is each of these products true,
To each man's gain, or loss in view.

EXAMPLE I.

Two Partners *A* and *B* enter into partnership, *A* puts in £80 for 7 months, and *B* £90 for 5 months, they traffic and gain £40. How must it be divided between them?

First, 80	× 7	= 560	the product of	*A*'s	stock & time.
and 90	× 5	= 450		*B*'s	
		Sum 1010			

	£		£	s	d		
Then as 1010 : 40 ::	560	:	22	3	$6\frac{3}{4}$ $\frac{9}{101}$	*A*'s	share of the gain.
	450		17	16	5 $\frac{92}{101}$	*B*'s	
			Proof £40	—	—		

EXAM-

EXAMPLE 2.

Three Butchers whose names we'll call *A*, *B* and *C*,
To hire a lea pasture together agree,
Just forty bright guineas *per annum* to pay,
To feed their cows jointly, as under we'll say;
A put in eight cows four months to a day,
And *B* put in ten cows three months and no more,
And *C* five for twelve months, then *Tyro* explore
What each of the annual Rent had to pay,
Come do me this quickly no longer delay?

$$\textit{First}\ \ \text{and}\left\{\begin{matrix}8\\10\\5\end{matrix}\right\}\times\left\{\begin{matrix}4\\3\\12\end{matrix}\right\}=\left\{\begin{matrix}32\\30\\60\end{matrix}\right\}\text{the prod. of}\left\{\begin{matrix}A\text{'s}\\B\text{'s}\\C\text{'s}\end{matrix}\right\}\text{Stock and Time.}$$

$$\text{Sum } 122$$

$$\textit{Then}\ \text{As } 122 : \overset{£}{42} :: \left\{\begin{matrix}32\\30\\60\end{matrix}\right\} : \left\{\begin{matrix}\overset{£}{11} & \overset{s}{—} & \overset{d}{3\frac{3}{4}\ \frac{45}{61}} & A\text{'s}\\10 & 6 & 6\frac{1}{2}\ \frac{46}{61} & B\text{'s}\\20 & 13 & 1\frac{1}{4}\ \frac{11}{61} & C\text{'s}\end{matrix}\right\}\text{Part of the Rent.}$$

$$\text{Proof } £42\ —\ —$$

Note. The Product of *C*'s Stock and Time being exactly double to *B*'s, makes *C* to pay exactly twice as much as *B*.

EXAMPLE 3.

A person dying left to four of his relations *A*, *B*, *C* and *D*, £140. *A* was to receive £50, *B* £40, *C* £30 and *D* £20, when each one had received his legacy, they agreed to make a Stock of the whole; *A* put his sum in for 6 months, *B* for 9 months, *C* for 12 months, and *D* for 15 months, by which they gain £200. What must each man receive of the gain in proportion to his Stock and the Time of employing it?

When

When many partners are concern'd it will be better to find a pound rate or common multiplier, as before taught in *Single Fellowship*, *page* 363, *viz.* by dividing the whole loſs or gain by the ſum of the products, and the quotient will be a pound rate, by which the product of each man's ſtock and time being multiplied, will produce his ſhare of the loſs or gain.

See the following Operation.

$$\left.\begin{matrix}50\\40\\30\\20\end{matrix}\right\}\times\left\{\begin{matrix}6\\9\\12\\15\end{matrix}\right\}=\left\{\begin{matrix}300\\360\\360\\300\end{matrix}\right\}\text{the prod. of}\left\{\begin{matrix}A\text{'s}\\B\text{'s}\\C\text{'s}\\D\text{'s}\end{matrix}\right\}\text{Stock and Time.}$$

$$\underline{1320})\overset{\pounds}{200.0}(.151515 \text{ Com. Multiplier.}$$

$$.151515\times\left\{\begin{matrix}\overset{\pounds}{300}\\360\end{matrix}\right\}=\left\{\begin{matrix}45.4545\\54.5454\end{matrix}\right\}=\left\{\begin{matrix}\overset{\pounds}{45} & \overset{s}{9} & \overset{d}{1}\\54 & 10 & 10\frac{3}{4}\end{matrix}\right.\left.\begin{matrix}A\text{'s}\\B\text{'s}\end{matrix}\right\}\text{ſhare of the gain.}$$

And as the Prod. of $\left\{\begin{matrix}A\text{'s}\\B\text{'s}\end{matrix}\right\}$ Stock and Time is equal to $\left\{\begin{matrix}D\text{'s}\\C\text{'s}\end{matrix}\right\}$ conſequently their Gain muſt be equal alſo.

EXAMPLE 4.

Five merchants *A B C D* and *E* companied and made a Stock of £4000

$$\left.\begin{matrix}A\text{'s}\\B\text{'s}\\C\text{'s}\\D\text{'s}\\\text{and } E\text{'s}\end{matrix}\right\}\text{Money was in}\left\{\begin{matrix}4\\6\\8\\10\\12\end{matrix}\right\}\text{Months}$$

whereby they gained £1400, which was divided in ſuch manner that

$$\text{and}\left\{\begin{matrix}\frac{1}{2}\\\frac{1}{3}\\\frac{1}{4}\\\frac{1}{5}\end{matrix}\right\}\text{of}\left\{\begin{matrix}A\text{'s}\\B\text{'s}\\C\text{'s}\\D\text{'s}\end{matrix}\right\}\text{Gain was equal to}\left\{\begin{matrix}\frac{1}{3}\\\frac{1}{4}\\\frac{1}{5}\\\frac{1}{6}\end{matrix}\right\}\text{of}\left\{\begin{matrix}B\text{'s}\\C\text{'s}\\D\text{'s}\\E\text{'s}\end{matrix}\right\}\text{Gain}$$

Quere, what did each merchant gain and put in?

Firſt,

First, If *A*'s Gain be ſuppoſed to be 2, then *B*'s will be 3, *C*'s 4, *D*'s 5, and *E*'s 6, which added together make 20. *Then*

$$\text{As } \overset{£}{20} : \overset{£}{1400} :: \overset{£}{\begin{Bmatrix} 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{Bmatrix}} : \overset{£}{\begin{Bmatrix} 140 & A\text{'s} \\ 210 & B\text{'s} \\ 280 & C\text{'s} \\ 350 & D\text{'s} \\ 420 & E\text{'s} \end{Bmatrix}} \text{Gain.}$$

Now having proceeded ſo far we have the whole Stock, each man's Gain and Time given, to find each man's particular Stock, which is eaſily obtained by the following general

RULE.

Multiply * each man's Loſs or Gain * continually
By each one's Time except his own,
This done—ſay by the *Rule of Three;*
As th' Sum of all theſe products be
To the whole Stock—ſo is you'll find,
Each of theſe Products ſo combin'd
To each man's Stock—be't leſs or more,
That you in numbers muſt explore.

$$\begin{Bmatrix} 140 \\ 210 \\ 280 \\ 350 \\ 420 \end{Bmatrix} \times \begin{Bmatrix} 6 \\ 4 \\ 4 \\ 4 \\ 4 \end{Bmatrix} \times \begin{Bmatrix} 8 \\ 8 \\ 6 \\ 6 \\ 6 \end{Bmatrix} \times \begin{Bmatrix} 10 \\ 10 \\ 10 \\ 8 \\ 8 \end{Bmatrix} \times \begin{Bmatrix} 12 \\ 12 \\ 12 \\ 12 \\ 10 \end{Bmatrix} = \begin{Bmatrix} 806400 \\ 806400 \\ 806400 \\ 806400 \\ 806400 \end{Bmatrix}$$

$$\overline{4032000}$$

As

As 4032000 : 4000 :: 806400 : 800 the Stock each Merchant advanced, for as the products are all *equal* the Stocks must be *equal also*, so that divide £4000 (the whole Stock) by 5 (the number of persons) and the quotient will be £800, *viz*. each one's Stock the same as above.

Or, Divide each person's gain by the time his money was in, and the quotients will be £25 the gain of each person for a month. *Then*, As $25\times5=125$ the sum of the gains *per* month, is to £4000 the whole Stock, so is £25 each man's monthly gain to $\frac{1}{5}$ of £4000 = £800 each person's Stock, as before.

Promiscuous Questions.

Question 1.

Taken from Hill's Arithmetic, *page* 284; *to which Mr.* Hill *has given* a very wrong Solution, *as many* Authors *do to Questions of this kind.*

A, *B* and *C*, company and put in together £3822. *A*'s money was in 3 months, *B*'s money was in 5 months, and *C*'s money was in 7 months: They gained £234, which was so divided as the $\frac{1}{2}$ of *A*'s Gain was equal to $\frac{1}{3}$ of *B*'s Gain, and $\frac{1}{3}$ of *B*'s Gain was equal to $\frac{1}{4}$ of *C*'s Gain: What did each merchant gain and put in?

If *A*'s Gain be supposed to be 2, then by the tenor of the Question *B* must have 3 and *C* 4, which added together make 9. *Then*

$$\text{As } 9 : \overset{£}{234} :: \left\{\begin{matrix}2\\3\\4\end{matrix}\right\} : \left.\left\{\begin{matrix}\overset{£}{52}\ A\text{'s}\\78\ B\text{'s}\\104\ C\text{'s}\\\hline 234\ \text{whole}\end{matrix}\right.\right\}\text{Gain}$$

Now we have the whole Stock, each man's Gain and Time given to find each man's particular Stock, to do which proceed according to the *Rule* given in *page* 372, and the work will stand as under.

$$\left.\begin{array}{r} 52\times5\times7=1820 \\ 78\times3\times7=1638 \\ 104\times3\times5=1560 \\ \hline \text{Sum } 5018 \\ \hline \end{array}\right\} \text{Products}$$

$$\left.\begin{array}{l} \text{As } 5018 : \overset{£}{3822} :: \left\{\begin{array}{r} 1820 \\ 1638 \\ 1560 \end{array}\right\} : \left\{\begin{array}{rrrl} \overset{£}{1386} & \overset{s}{4} & \overset{d}{4-\frac{176}{193}} & A\text{'s} \\ 1247 & 11 & 11-\frac{4}{193} & B\text{'s} \\ 1188 & 3 & 8\frac{3}{4}\frac{13}{193} & C\text{'s} \end{array}\right. \\ \hline \qquad\qquad \text{Proof } £3822 \text{ — — the whole} \\ \hline \end{array}\right\} \text{Stock.}$$

Or thus,

$$\begin{array}{l} 3)\ \overset{£}{52}(\overset{£}{17\frac{1}{3}} \\ 5)\ 78(15\frac{3}{5} \\ 7)\ 104(14\frac{6}{7} \end{array} = \left.\left\{\begin{array}{ll} \overset{£}{17\frac{35}{105}} & A\text{'s} \\ 15\frac{63}{105} & B\text{'s} \\ 14\frac{90}{105} & C\text{'s} \end{array}\right.\right\} \text{Gain } per \text{ month.}$$

$$\text{Sum } 47\tfrac{83}{105}$$

$$\text{As } £47\tfrac{83}{105} : \overset{£}{3822} :: \left\{\begin{array}{r} \overset{£}{17\frac{35}{105}} \\ 15\frac{63}{105} \\ 14\frac{90}{105} \end{array}\right\} : \left\{\begin{array}{l} A\text{'s} \\ B\text{'s} \\ C\text{'s} \end{array}\right\} \text{Stock, the same as above.}$$

Note. Mr. *Hill* (in his Arithmetic *page* 285) makes each one's Stock to be as under, *viz.*

$$\left.\begin{array}{lr} & £ \\ A\text{'s} & 468 \\ B\text{'s} & 1170 \\ C\text{'s} & 2184 \end{array}\right\} \text{instead of} \left\{\begin{array}{rrr} \overset{£}{1386} & \overset{s}{4} & \overset{d}{4-\frac{176}{193}} \\ 1247 & 11 & 11-\frac{4}{193} \\ 1188 & 3 & 8\frac{3}{4}\frac{13}{193} \end{array}\right\} \text{the true Stock found as above.}$$

Quef-

Question 2. by *Buteo*, (Publish'd near 200 Years ago.)

A Merchant's real Stock being £120 and the Factor's £60, they agreed that at the year's end the Factor should have $\frac{1}{2}$ of both Stock and Gain, but they broke up at 8 month's end having gained £150. How much ought the Factor to have?

First, £120 + £60 = £180 the whole Stock, half of which is £90 each man's share thereof at the year's end, whereby it is plain that had the Stock continued in trade during that time, the Factor must have had £30 of the Merchant's Stock, but as it continued only 8 months or $\frac{2}{3}$ of a year, therefore $\frac{2}{3}$ of £30 = £20 is the Factor's share of the Merchant's Stock, which share

being	taken from	£120	leaves	£100	the	Merch't's
	added to	60	makes	80		Factor's

Stock at the 8 months end or time of breaking up.

				£	s	d			
2dly. As £180 : £150 ::	£100	:	83	6	8	the	Merch't's	gain.
	80		66	13	4		Factor's	

	£		£	s	d		£	s	d			
Then,	100	+	83	6	8	=	183	6	8	the	Mer't's	Share of the whole
and	80		66	13	4		146	13	4		Fac't's	

BARTER.

BARTER, discovers you will see,
The worth of each commodity,
That is exchang'd, or truck'd in trade,
The terms be what they will that's made,
And no one party, loss sustain,
As underneath I shall explain.

RULE.

First find the value of what's sold,
Whose given quantity is told,
Then for this worth you must find true,
What quantity o'th' other's due,
At th' given rate, and then you may
An answer find without delay.
When goods are rated something more
Than ready money price, be sure,
Proportion thus—now to go on
As th' ready money price of one,
Is to its Bart'ring price, I say,
So is the money price alway
Of th' other to its Bart'ring price,
This done, now *Tyro* in a trice;
You'll quickly find the quantity,
O'th' party's last commodity;
From th' ready money, (mind me still)
Or Bart'ring price, be what it will.

EXAMPLE I.

Suppose I have 300 yards of linen Cloth, worth 18*d* *per* yard, which I would truck for Cheese at 32*s* *per* C. of 120 lb to the C. How much Cheese must I receive for my linen Cloth?

	d	£		*s*	*d*	
	6 | $\frac{1}{4}$ |	30.0	the Price of the Linen at	2	—	
	Deduct	7.5		—	6	
s £ 32 = 1.6	2)	22.5		1	6	*per* yard
	8)	11.25		—	9	

Answer, C 14.0625 = C 14 — 7 $\frac{1}{2}$ (*qr* — , *lb* 7 $\frac{1}{2}$)

EXAM-

EXAMPLE 2.

A and *B* Barter, *A* hath 200½ yards of Kersey at 9*s* 6*d* *per* yard; *B* hath 80 yards of Velvet at 1 guinea *per* yard. *Quere*, which must pay balance, and how much?

		£	s	d		£	s	d	
10*s*	½	200	10	—	the value of the Kersey at	1	—	—	per Yard.
6*d*	$\frac{1}{20}$	100	5	—		—	10	—	
Deduct		5	—	3		—	—	6	
From		95	4	9		—	9	6	
Take		84	—	—	Velvet at £1 1*s*				
Rems.		£11	4	9	Kersey more than the Velvet which must be paid by *B* to *A*.				

EXAMPLE 3.

A Farmer sold to a Maltster 364 bushels of Barley at 3*s* 8*d* *per* bushel, for which he received by agreement 50 bushels of Malt and £54 6*s* 9*d* in Cash. What was the Malt valued at *per* bushel?

		£	s	d		£	s	d	
4*s*	⅕	364	—	—	the value of the Barley at	1	—	—	per Bushel
4*d*	$\frac{1}{12}$	72	16	—		—	4	—	
Deduct		6	1	4		—	—	4	
From		66	14	8		—	3	8	
Dedt.		54	6	9	Cash receiv'd				
50	(5)	12	7	11	the value of the Malt,				
	10)	2	9	7	10 Bushels thereof.				
Answer			4	11½	1 Bushel thereof.				

Example 4.

C, hath Corn at five shillings *per* bushel, not more,
But in Barter will have just one third of a score.
D, a *Manchester* Tradesman, hath Fustians we find,
Worth in ready money the sum here subjoin'd. *
Then how much *per* yard must the Fustian by *D*,
Be rated equivalent with *C*'s to agree?

As 5*s* the ready Money price of the Corn, is to 6*s* 8*d* the bartering price, so is 2*s* 9½*d* the ready money price of the Fustian, to 3*s* 8½*d* $\frac{2}{3}$, the bartering price thereof.

Promiscuous Questions.

Question 1. by Mr. *John Saxton.*

(See his Arithmetic *page* 289.)

A and *B* Barter, *A* has 1375 yards of Shalloon at 19*d per* yard, for which *B* gives him broad Cloth at 17*s* 4*d per* yard, and a Bill of £50 due 6 months hence. How many yards must *A* give *B* besides the Bill?

		£	s	d			£	s	d	
1s	$\frac{1}{20}$	1375	—	—	the value of the	Shalloon at	1	—	—	per yard
6d	$\frac{1}{2}$	68	15	—			—	1	—	
1d	$\frac{1}{6}$	34	7	6			—	—	6	
		5	14	7			—	—	1	
From		108	17	1			—	1	7	
Dedt.	†	48	15	7¼		£50 Bill discounted.				
Rems.		£60	1	5¾		Broad Cloth at 17*s* 4*d p.* yd.				

As 17*s* 4*d* : 1 yd. :: £60 1*s* 5*d* ¾ : 69 yds. 5 nls. Ansr.

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* 2*s* 9½*d per* yard.

† The present worth of the Bill is easily known by proceeding according to *Cor.* 2 in Simple Interest *page* 331, or by the Rule in *page* 351, thus, As £102 10*s* (the amount of £100 for 6 months at lawful Interest) is to (its principal, or present worth) £100 so is £50 (the value of the Note) to £48 15*s* 7*d* ¼ the present worth, as above.

Ques-

Question 2. by Mr. *Hatton.*

Two Merchants have various kinds of goods to Barter. *A* hath 735 yards of *Indian* Silk at 8*s* 6*d* *per* yard ready money, and in Barter 10*s*, also 532 Canes at 3*s* a piece ready money, and in Barter 3*s* 4*d*, and 16 pieces of Muslin at £4 a piece ready money, and in Barter £4 10*s*. *B* hath scarlet Cloth at £1 *per* yard ready money; Glass Manufacture at 1*s* 8*d* *per* pound ready money, and a finer kind at 2*s* 4*d* *per* pound. How many yards of Cloth and pounds of each kind of Glass of all alike number must *B* give *A* advancing his goods proportionally also in Barter?

		s	d		£	s	d
A's	Silk, 735 yds. at	8	6 *per* yd.	comes to	312	7	6
	Canes, 532 at 3*s* a piece				79	16	–
	Muslin, 16 pieces at £4 a piece				64	—	–
				Sum	£456	3	6

The Price of 1		of *B*'s		£	s	d
	yd		Scarlet Cloth.	1	–	–
	lb		Glass Manufac.	–	1	8
	lb		finer sort.	–	2	4
			Sum	£1	4	–

Now divide 109482 the pence in £456 3*s* 6*d* by 288 the pence in £1 4*s*, and the quotient will be $380\frac{42}{288} = 380\frac{7}{48}$ the Answer.

L O S S and G A I N.

By *Loss and Gain*, you're learned fair,
To act with Justice and prepare
The price of each commodity,
In such proportion to agree
That no one injured shall be,

When-

Whene'er the Loss or Gain is given
O'th' quantity be't odd or even,
To find th' value of any part
Thereof, pray get this Rule by heart.

RULE.

First say as the whole quantity
Of goods, or ware, whate'er they be,
Is to the sum of Cost and Gain,
So's any part I will maintain,
Of the said goods be what they will,
To th' price they're sold for,—mind me still,
And when the Gain or Loss is found
So much *per Cent.*—one hundred pound
Add to the Gain, if Loss substract,
To make your second term exact.

EXAMPLE 1.

Admit a Cheesemonger buys 8 Ton, 12 C. 3 qrs. 8 lb of Cheese, at £1 14s 6d *per* C. and sells it out again at £2 3s 9d *per* C. What does he Gain upon the whole?

	£	s	d			
First from	2	3	9	the	Selling Price	of
Take	1	14	6		Prime Cost	
C						*T C q lb*
Then, As 1 is to	–	9	3		Gain of a *C*. so is	8 12 3 8

to £79 18s 7d the Answer.

EXAMPLE 2.

If two pence three farthings *per* Shilling I gain,
My profit *per Cent.* Tyro to me explain?

d		£	s	d		d	
3	$\frac{1}{4}$	100	–	–	the Gain *per Cent.* at	12	*per* Shilling Profit.
$\frac{1}{4}$	$\frac{1}{12}$	25	–	–		2	
Deduct		2	1	8		$\frac{1}{4}$	
Rems.		£22	18	4		$2\frac{3}{4}$	

Or, As $\overset{s}{1}:\overset{d}{2\frac{3}{4}}::\overset{£}{100}:\overset{£\ s\ d}{22\ 18\ 4}$ the Answer as above.

EXAM-

EXAMPLE 3.

If Cloth for twelve Shillings *per* yard I can buy,
Then how must I sell it be pleas'd to descry,
To gain thirty *per Cent.* for the use of my cash,
Should I happen to sell it to *Timothy Flash*?

£		s	d				£	
20	$\frac{1}{5}$	12	–	the	Prime Cost of a Yard			
		2	$4\frac{3}{4}\frac{1}{5}$		Gain	of a Yard at	20	per Cent. Profit.
10	$\frac{1}{2}$	1	$2\frac{1}{4}\frac{3}{5}$				10	
Ans.		s 15	7 $\frac{4}{5}$		Price		30	

Or, As £100 : £130 :: 12s : 15s 7 – $\frac{4}{5}$d the Answer as above.

EXAMPLE 4.

By damaged Stockings suppose I should lose,
Nine farthings *per* Shilling by selling my Hose,
Then how much *per Cent.* should I lose by my Ware,
Ingenious young *Tyro*,—be pleas'd to declare.

d		£	s	d			d	
2	$\frac{1}{6}$	100	—	—	the Loss *per Cent.* at		12	*per* Shilling.
							2	
$\frac{1}{4}$	$\frac{1}{8}$	16	13	4			$\frac{1}{4}$	
			2	1	8		$2\frac{1}{4}$	
Ansr.		£18	15	—				

Or, As 1s : $2\frac{1}{4}$d :: £100 : £18 15s the Answer as above.

EXAMPLE 5.

Suppose a *Manchester* Tradesman buys Yarn, to the value of £240, and sells the same out again immediately for £254 10s 6*d* with 6 months Credit. What does he gain *per Cent*? *First,*

First, From £ *248 6*s* 4*d* the present worth of £254 10*s* 6*d*, (being what the Yarn was sold for at 6 months Credit) deduct £240 (the prime Cost) and there will remain £8 6*s* 4*d*, the Gain upon the whole.

	£		£ s d		£		£ s d	
Then, As	240	:	8 6 4	::	100	:	3 9 3½	the Answer.

Or, As £240 (the prime Cost of the Yarn) is to £14 10*s* 6*d* (the whole Gain had there been no Credit,) so is £100 to £6 1*s* –*d* ½ the Gain *per Cent*. had the Yarn been sold for ready Money, but 6 months Credit being given, therefore deduct the Rebate of £106 1*s* –*d* ½ for 6 months, (which will be easily found by the *Rule* in *page* 351) from £6 1*s* –*d* ½ and there will remain £3 9*s* 3*d* ½ the Answer the same as before.

Remark.

Some Authors take Questions of this kind in a different sense, and would solve the preceding Question thus,

	£		*Gain*		£		*Gain*	
As	240	:	14.525	::	100	:	6.052.	and then say

	Mon:		*Gain*		*Mon*.		*Gain*		£ s d	
As	6	:	6.052	::	12	:	12.104	=	12 2 1.	which they

would call the Answer: In this manner Mr. *Birks* solves Question 23, in his Arithmetic, *page* 378, but this method (according to the conditions of the Question) is *very* erroneous.

EXAMPLE. 6.

A *Sportsman* coursing near the Banks of *Dee*,
Up bounces *Puss*—just sixty Yards † was she
Before the Dog,—but *Smoker* dont her see

* *Note*. The present worth of £254 10*s* 6*d* for 6 months at lawful Interest is easily found by *Cor*. 2 in Simple Interest, *page* 331, or by the *Rule* in *page* 351 to be £248 6*s*. 4*d* as above.

† *i. e.* Sixty Yards before the Greyhound at her first getting up.

Till

'Till fifty seconds were elaps'd, not more,
Then *John* espies her, and cries out *To-ore*,
Now *Smoker* skims along the chequer'd Plains,
The woods resound to th'em'lous *Sportsman*'s strains.
Poor *Puss* is taken, and the Chase is done,
The Time ascertain, and what Ground was run;
When *Smoker* leap'd at twenty miles *per* hour,
And *Puss* just at the rate of four times four.

Hour Miles Secds Yards

First, As 1 : 16 :: 50 : $391\frac{1}{9}$ which add to 60 and the Sum will be $451\frac{1}{9}$ yards the Distance the Hare had at start. Now as (by the Question) the Dog's rate was 4 miles an hour more than the Hare's, therefore

Miles Hour Yards Min Secds
As 4 : 1 :: $451\frac{1}{9}$: 3 $50\frac{15}{22}$ the Time. ran by the Dog.
Hour Miles Min Secds Yards
Then As 1 : 20 :: 3 : $50\frac{15}{22}$: $2255\frac{5}{9}$ the Dist. ran by the Dog.

But the Distance ran by the Dog may be easily found without knowing the Time he ran, for it is plain by the Question, that in running 20 miles he would gain 4 *viz*. $\frac{1}{5}$, consequently $451\frac{1}{9}$ yards (the Distance the Hare had at start) must be $\frac{1}{5}$ of the

Yards
Chase, and 5 times $451\frac{1}{9} = 2255\frac{5}{9}$ the Dist. as above.
Miles Hour Yards Min Secs
And *then* As 20 : 1 :: $2255\frac{5}{9}$: 3 $50\frac{15}{22}$ the Time as above.

Note. The above Question I propos'd many years ago, and inserted it in a Miscellany of Poems and Mathematical Articles which I published in the year 1768; and as both Loss and Gain are concerned in the Question, I thought it might very properly come under the denomination of this Rule.

PRO-

PROMISCUOUS QUESTIONS.

Question 1. by Mr. *Webster*.

See the second Edit. of his Arithmetic, *page* 32.

If by selling Cloth at 5*s* *per* Ell I gain £8 *per Cent.* What shall I gain *per Cent.* if I sell the Ell at 6*s* 3*d*?

£
First to 100
Add 8

Then As 5*s* : 108 :: 6*s* 3*d* : £135, from which deduct £100 and there will remain £35 the Answer, which in Mr. *Webster*'s Arithmetic is only £10.

Note. This and the four following Questions Mr. *Vyse* has taken into his Arithmetic, because their Authors have solved them wrong, the Error consists in the stating of the Questions, by making the Gain or Loss of £100 the second term instead of its Amount.— Mr. *Hutton* likewise remarks upon these Questions, but as neither of these ingenious Gentlemen have shewn the young *Tyro* how to proceed properly to solve them, I therefore thought it necessary to give them a place in this Treatise.

Question 2. by Mr. *Stonehouse*.

See the second Edit. of his Arithmetic, *page* 103.

At 5*s* *per* Dozen I gain £7 10*s* *per Cent.* how much shall I gain *per Cent.* if I sell the Dozen at 5*s* 9*d*?

As 5*s* : £107 10*s* :: 5*s* 9*d* : £123 12*s* 6*d*. from which deduct £100 and there will remain £23 12*s* 6*d* the Answer, which in Mr. *Stonehouse*'s Arithmetic is only £8 12*s* 6*d*.

Ques-

Question 3. by Mr. *Hill.*

See the 10th Edition of his Arithmetic, *page* 289.

A *Manchester* Chapman going to a Fair, sold Fustians for 11*s* 6*d* the End, wherein was gained £15 *per Cent.* and seeing no other Chapman had so good, raiseth them at the latter end of the Fair to 12*s*. I demand what he gained *per Cent.* by this last Sale?

s d £ *s* £ £
As 11 6 : 115 :: 12 : 120, from which deduct 100 and the remainder will be £20 the Answer, which in Mr. *Hill*'s Arith. is only £15.652 &c.=£15 13*s* – *d* ½.

Question 4. by Mr. *Dilworth.*

See the second Edit. of his Arithmetic, *page* 73.

Suppose I sell 500 Deals at 15*d per* piece and £9 *per Cent.* loss. What do I lose by the whole Quantity?

£
First from 100
Take 9

£ £ *s*
Then As 91 : 100 : 31 5 (the price of the Deals at 15*d* a piece): £34 6*s* 9*d* ¾, from which deduct £31 5*s*, and there will remain £3 1*s* 9*d* ¾ the Answer, which in Mr. *Dilworth*'s Arithmetic is only £2 16*s* 3*d*.

Question 5. by Mr. *Walkingham.*

See the third Edition of his Arithmetic, *page* 70.

Snppose I sell 1 *Cwt.* of Hops for £6 15*s* and gain £25 *per Cent.* What would have been the gain *per Cent.* if I had sold them for £8 *per Cwt?*

£ *s* £ £ £ *s d*
As 6 15 : 125 :: 8 : 148 2 11 ⅟₉, from which deduct £100 and there will remain £48 2*s* 11*d* ⅟₉ the Answer, which in Mr. *Walkingham*'s Arith. is only £29 12*s* 7*d*.

E X C H A N G E.

EXCHANGE confifts in finding fair,
What quantities of Monies are
In diff'rent places equal, and
The fame—as you will underftand.
To work *Exchange* confpicuoufly,
Ufe *Practice*, or, the *Rule of Three*.

The *Courfe* of *Exchange* between any two kingdoms, rifes and falls upon different occafions; *i. e.* is fometimes above and fometimes below the *Par*.

The *Par* of Exchange is always fixed, it being the intrinfic value of any *foreign* money compared with *Sterling*.

Money in the Bank of other kingdoms, is finer, or purer than that which is current, the difference of value in each is called *Agio*.

As there would be no end in treating of every kind of *Exchange*, in all *Countries*, I fhall only treat of the *Exchange* of *England*, with a few of the chiefeft Countries in *Europe*, &c.

First. *With IRELAND, AMERICA, and the WEST-INDIES.*

In thefe Countries their accounts are kept in Pounds Shillings and Pence the fame as in *England*.—The *Par* of Exchange between *England* and *Ireland* is £100 *Sterling* for £108 6*s* 8*d* *Irifh*, *viz.* 1*s* *Englifh* for 13*d* *Irifh*.—The *Courfe* of Exchange is from 5 to 12 *per Cent*. according to the balance in trade.

In *America* their Money is called *Currency*. In the *Weft-Indies* £5 *Sterling* is worth 7 of the *Currency*, owing to the great plenty of foreign coins circulating there; but on the *Continent* of *America*, cafh is fo fcarce that they are obliged to fubftitute *Paper Currency* to carry on trade, which being fubject to cafualties, fuffer a great difcount in the purchafing of Bills of Exchange.

EXAM-

EXAMPLE 1.

London remits to *Dublin* £1460 10*s* *Sterling*. What must be receiv'd there, Exchange at £110$\frac{1}{2}$ *per Cent*?

		£	s	d		£	
10 | $\frac{1}{10}$		1460	10	–	the value at	100	*per Cent.*
$\frac{1}{2}$ | $\frac{1}{20}$		146	1	–		10	
		7	6	– $\frac{1}{2}\frac{2}{5}$		$\frac{1}{2}$	
Answer		1613	17	– $\frac{1}{2}\frac{2}{5}$		110$\frac{1}{2}$	

£ £ £ s £ s d

Or, As 100 : 110$\frac{1}{2}$: 1460 10 = 1613 17 – $\frac{1}{2}\frac{2}{5}$ the Answer as above.

EXAMPLE 2.

Dublin remits to *London* £1613 17*s* –*d* $\frac{1}{2}\frac{2}{5}$. What must be receiv'd there, Exchange at £110$\frac{1}{2}$ *per Cent*?

£ s £ £ s d £ s

As 110 10 : 100 :: 1613 17 – $\frac{1}{2}\frac{2}{5}$: 1460 10 the Anf.

EXAMPLE 3.

Admit any part of the *West-Indies* is indebted to *London* in £4168 16 10$\frac{1}{2}$ *Currency*. What *Sterling* must be receiv'd for the same, the Exchange being £150 *per Cent*?

£ £ £ s d £ s d

As 150 : 100 :: 4168 16 10$\frac{1}{2}$: 2779 4 7 the Answer.

But *Note*, the work of the *Rule of Three* may often be much abbreviated by placing the first and second terms, or the first and third terms of the stating, as a vulgar fraction, making the first term the denominator of such fraction, and reducing it to its lowest terms,

 for

for the value of that fractional part of the other term will be the answer, thus: the first and second terms in the preceding stating placed as a fraction become $\frac{100}{150}=\frac{2}{3}$ in its lowest terms, then $\frac{2}{3}$ of the other term £4168 16*s* 10*d* $\frac{1}{2}$ will (by *Case* 12 in Vulgar Fractions, *page* 255, or by *Article* 2, *page* 274,) be easily found to be £2779 4*s* 7*d*, the same as in the preceding *page*.

Example 4.

Suppose *London* receives a bill of Exchange from any part of the *West Indies* for £2779 4*s* 7*d Sterling*. For how much *Currency* was *London* indebted, Exchange being at 50 *per Cent?*

£		£	s	d		£	
50	$\frac{1}{2}$	2779	4	7	the value at	100	per Cent.
		1389	12	$3\frac{1}{2}$		50	
Ans.		£4168	16	$10\frac{1}{2}$		150	

Second, *With HOLLAND, FLANDERS, and GERMANY.*

In these Countries their accounts are kept in Pounds, Shillings and Pence, as in *England*, and sometimes in Guilders, Stivers and Pennings.——In *Holland* and *Flanders* the Money is distinguished by the name of *Flemish*; Exchange being made with *London* from 30*s* to 38*s Flemish per* Pound *Sterling*.

NOTE.

8 Pennings	make one	Groat	30 Stivers	make one	Flor. or Guild.
2 Groats		Stiver	$2\frac{1}{2}$ Florins		Rix Dollar
6 Stivers		Shilling	6 Florins		Pound *Flemish*
			5 Guilders		Ducat

Exam-

EXAMPLE 1.

How much *Flemish* will £840 *Sterling*, amount to Exchange being at *Par, viz.* 33*s* 4*d* *Flemish per* Pound *Sterling?*

	£	£ s d		£	£	
As	1 :	1 13 4	::	840 :	1400	the Answer.

Or, by the *Note* in *page* 387.——The pence in a pound *Sterling*, and 33*s* 4*d* placed as a fraction and reduced to its lowest terms become $\frac{5}{3} = 1\frac{2}{3}$ therefore to £840 add the $\frac{2}{3}$ of itself and the sum will be £1400 the same as above.

EXAMPLE 2.

How much *Sterling* will £1400 *Flemish* amount to, Exchange at 33*s* 4*d* *per* pound *Sterling?*

	£ s d		£		£	£	
As	1 13 4	:	1	::	1400 :	840	the Answer.

Or $\frac{240}{400} = \frac{3}{5}$, and $\frac{3}{5}$ of £1400 = £840 as above.

COROLLARY.

When *Flemish* Pounds Shillings and Pence are to be reduced to Guilders.—Divide the whole Sum when reduced into Pence *Flemish* by 40 (the number of Pence in one Guilder) and the quote will be Guilders, the remainder (if any) will be Pence, which divide by 2 (the Pence in one Stiver) and the quotient will be Stivers.

EXAMPLE 3.

In £846 16*s* *Flemish*, how many Guilders?

```
          £   s
         864  16
          20
       ------
        17296
           12
       ------
  4|0) 20755|2
       ------
                          Guil. Stiv.
Answer 5188 32/40 Guilders = 5188 16
```

 EXAM-

Example 4.

In 5188 *Guil.* 16 *St.* How many *Flemish* Pounds?

Guil. St.
5188 16 = 32*d.*
40

12)207552

2|0)1729|6

£864 16*s* Anf.

Corollary 2.

When you are to change *Current* money into *Banco*, and *Banco* into *Current*, they muft be proportioned thus, As 100 with the *Agio* added to it, is to 100 *Banco*, fo is any given fum *Current* to its value in *Banco*. And as 100 is to 100 with the *Agio* added to it, fo is the *Banco* given to its value *Current*.

☞ *Bank* money being worth more than *Current*, the difference is called *Agio*, and is from 3 to 6 *per Cent.* in the *Bank*'s favour.

Example 5.

Change 110 Guilders 12 Stivers *Current*, into *Banco* Florins, *Agio* 4 *per Cent.*

Guil. Guil. Guil. St. Guil. St. Gr. Pen.
As 104 : 100 :: 110 12 : 106 6 1 6 the Anf.

Example 6.

Change 340 Guilders 12 Stivers *Banco* into *Current*, *Agio* 4⅝ *per Cent.*

Guil. Guil. St. Gr. Guil. St. Guil. St.
As 100 : 104 12 1 :: 340 12 : 356 7 Anfwer.

Third, *With* FRANCE.

At *France* accounts are kept in Livres Sols and Deniers, Exchange being made by the *French* Crown, whofe *Par* is 4*s* 6*d* *Sterling*.

Note. Twelve Deniers make 1 Sol, or Sou; 20 Sols 1 Livre, and 3 Livres 1 Crown, or Ecu.

Exam-

EXAMPLE 1.

What *Sterling* money muſt a Merchant pay in *London* to receive in *Paris* 4000 Crowns, Exchange at 54*d per* Crown, or Ecu?

C *d* *C* *£*

As 1 : 54 :: 4000 : 900 the Anſwer.

EXAMPLE 2.

What number of Crowns muſt be paid at *Paris* to receive in *London*, £900, Exchange 54*d per* Crown?

d *C* *£* *C*

As 54 : 1 :: 900 : 4000 the Anſwer.

EXAMPLE 3.

What will 140 Livres, 6 Sols, 8 Deniers amount to in *London*, at 56*d per* Crown or Ecu at *Paris*?

Cr. *d* *Liv. ſol den.* *£* *s* *d*

As 1 : 56 :: 140 6 8 : 10 18 3 $\frac{1}{9}$ the Anſwer.

EXAMPLE 4.

To how much *French* money will £10 18*s* 3*d* $\frac{1}{2}$ *Sterling* amount, Exchange at 56*d per* Crown?

d *C* *£* *s* *d* *Liv. ſol den*

As 56 : 1 :: 10 18 3 $\frac{1}{2}$: 140 6 8 nearly Anſwer.

Fourth, *With* SPAIN.

In this Kingdom they keep their accounts in Piaſtres, Reals and Marvadies, and Exchange by the Piaſtre, whoſe *Par* is 4*s* 6*d* *Sterling*.

Note. 372 Marvadies make 1 Rial, and 8 Rials 1 Piaſtre.

EXAM-

Example 1.

For six hundred Guineas of good *British* gold,
How many Piastres I pray let be told,
Exchange fifty pence, *per* Piastre, not more,
All this with much ease you may quickly explore?

d Pi. Guin. Pi.

As 50 : 1 :: 600 : 3024 the Answer.

Example 2.

Suppose *Spain* draws upon *London* for 3024 Piastres: What *Sterling* money will this draught amount to, when the Exchange is 50*d per* Piastre?

Pi. d Pi. £

As 1 : 50 :: 3024 : 630 the Answer.

Example 3.

Change £4000 10*s* 4*d* $\frac{3}{4}$ *Sterling* into *Spanish* money, Exchange at 54*d* $\frac{1}{4}$ *per* Piece of Eight?

d P. £ s d Pieces

As 54$\frac{1}{4}$: 1 :: 4000 10 4$\frac{3}{4}$: 17698$\frac{33}{217}$, Answer.

Example 4.

Admit *Bilboa*, or any part of *Spain* remits to *London* 160 Piastres, 3 Rials, 8 Marvadies, Exchange at 51*d* $\frac{1}{2}$ *per* Piastre: What will this remittance amount to in *Sterling* money?

P. d P. ri. mar. £ s d

As 1 : 51$\frac{1}{2}$ :: 160 3 8 : 34 8 3$\frac{1}{4}$ $\frac{299}{372}$ the Answer.

Fifth, *With PORTUGAL.*

Accounts are kept in *Portugal* in Milreas and Reas, and they Exchange by the Milrea, whose *Par* is about 6*s* 8*d* $\frac{1}{2}$ or 6*s* 9*d Sterling*.

Note. 400 Reas make 1 Crusadoe, and 1000 Reas, 1 Milrea.

Exam-

EXAMPLE 1.

A Merchant at *Lisbon* remits to his Correspondent in *London* 1000 Milreas. How much *Sterling* must he receive, Exchange at 5*s* 6*d per* Milrea?

s		£		£ s d	
5	$\frac{1}{4}$	1000	the value in *Sterling* money at	1 – –	*per* Milrea.
d					
6	$\frac{1}{10}$	250		– 5 –	
		25		– – 6	
Answer		£275		– 5 6	

EXAMPLE 2.

To how much *Sterling* will 190 Milreas 604 Reas amount, Exchange at 70*d* $\frac{1}{4}$ *per* Milrea?

Mil. *d* *Mil.* *Reas* £ *s* *d*

As 1 : 70$\frac{1}{4}$ :: 190 604 : 55 15 9$\frac{3}{4}$ $\frac{181}{250}$ the Ans.

EXAMPLE 3.

How many Milreas will £55 15*s* 9*d* $\frac{3}{4}$ $\frac{181}{250}$ amount to, Exchange at 70*d* $\frac{1}{4}$ *per* Milrea?

d *M.* £ *s* *d* *Mil. Reas*

As 70$\frac{1}{4}$: 1 : 55 15 9$\frac{3}{4}$ $\frac{181}{250}$: 190 604 the Answer.

SCHOLIUM.

When several weights or measures of different countries are compared together, and it is required to find how many of the one are equal to a given quantity of the other.—First place the numbers alternately under each other in two straight columns, in such manner that no two terms of one kind may be found in one and the same column, then multiply the numbers together in the least column for a divisor, and the numbers in the other column (where the odd term is) for a dividend, and the quotient will be the answer.—The work may often be abridged by rejecting numbers that are alike in both columns.

EXAM-

Example 1.

If 1 Cwt. of goods at *London*, are equal to 124 ℔ at *Paris*, and 112℔ at *Paris* are equal to 100℔ at *Lisbon*. How many pounds at *London* are equal to 140℔ at *Lisbon?*

$$\begin{array}{rl} & ℔ \\ \textit{First} & \left.\begin{array}{r} 112 \\ 112 \\ 140 \end{array}\right\} \text{at} \left\{\begin{array}{l} \textit{London} \\ \textit{Paris} \\ \textit{Lisbon} \end{array}\right. \end{array} \qquad \begin{array}{c} ℔ \\ \left.\begin{array}{r} 124 \\ 100 \end{array}\right\} \text{at} \left\{\begin{array}{l} \textit{Paris} \\ \textit{Lisbon} \end{array}\right. \end{array}$$

Then per Scholium. $112 \times 112 \times 140 = 1756160$ the Dividend, and $124 \times 100 = 12400$ the Divisor, by which divide 1756160 and the quotient will be 141 ℔ $\frac{97}{155}$ the Answer.

Example 2.

If 100℔ at *Copenhagen* be equal to 80℔ at *Rome*, and 100℔ at *Rome* be equal to 114℔ at *Madrid*.— How many pounds at *Madrid* are equal to 180℔ at *Copenhagen?*

$$\begin{array}{rl} & ℔ \\ \textit{First} & \left.\begin{array}{r} 100 \\ 100 \end{array}\right\} \text{at} \left\{\begin{array}{l} \textit{Copenhagen} \\ \textit{Rome} \end{array}\right. \end{array} \qquad \begin{array}{c} ℔ \\ \left.\begin{array}{r} 80 \\ 114 \\ 180 \end{array}\right\} \text{at} \left\{\begin{array}{l} \textit{Rome} \\ \textit{Madrid} \\ \textit{Copenhagen} \end{array}\right. \end{array}$$

Then per Scholium in the preceding *page*. $80 \times 114 \times 180 = 1641600$ the Dividend, and $100 \times 100 = 10000$ the Divisor, by which divide 1641600 and the quotient will be 164*lb.* $\frac{4}{25}$ the Answer.

Promiscuous Questions.

Question 1. by Mr. *John Ward.*

See his Mathematicians Guide, *page* 108. 5th Edit.

Suppose I would Exchange £527 17*s* 6*d* for Dollars at 4*s* 6*d* a piece, Ducats at 5*s* 8*d* a piece, and Crowns at

at 6*s* 1*d* a piece, and would have 2 Dollars for 1 Ducat, and 3 Dollars for 2 Crowns. How many of each ſort muſt I have?

Firſt 54*d*=1 Dollar, 68*d*=1 Ducat, 73*d*=1 Crown and 126690*d* = £527 17*s* 6*d*. *Then*, as (*per* Queſtion) there muſt be

$$\left.\begin{array}{r} 2 \\ \text{and } 3 \end{array}\right\} \text{ Dollars for } \left\{\begin{array}{l} 1 \text{ Ducat} \\ 2 \text{ Crowns} \end{array}\right.$$

conſequently it will be but

$$\left.\begin{array}{r} \frac{1}{2} \\ \text{and } \frac{2}{3} \end{array}\right\} \text{ of a } \left\{\begin{array}{l} \text{Ducat} \\ \text{Crown} \end{array}\right\} \text{ for 1 Dollar}$$

therefore $54 + \dfrac{68}{2} + \dfrac{2 \times 73}{3} = 136\frac{2}{3}$ the Diviſor, by which divide 126690*d* (ſee *Diviſion of Vulgar Fractions*) and the quotient will be

$$\left.\begin{array}{r} \text{and the quotient will be } 927 \\ \left.\begin{array}{r} \frac{1}{2} \\ \text{and } \frac{2}{3} \end{array}\right\} \text{ of which is } \left\{\begin{array}{l} 463\frac{1}{2} \\ 618 \end{array}\right. \end{array}\right\} \text{the No. of} \left\{\begin{array}{l} \text{Dollars} \\ \text{Ducats} \\ \text{Crowns} \end{array}\right\} \text{requir'd.}$$

Queſtion 2 by Mr. *Malcolm*.

If I receive 11 Crowns an 7 Dollars for £4 10*s* 10*d*, or 4 Crowns and 3 Dollars for £1 15*s* the value of 1 Crown and 1 Dollar being the ſame in both. What is that Value?

$$\begin{array}{rrrr} & £ & s & d \\ \textit{Firſt} & 4 & 10 & 10 \\ \text{and} & 1 & 15 & 0 \end{array}\Bigg\} = \left\{\begin{array}{r} d \\ 1090 \\ 420 \end{array}\right.$$

$$\begin{array}{lrcrcr|c|c|c|c|rcrcr} & d & & Cr. & & Do. & & & & & d & & Cr. & & Do. \\ \textit{Then} & 1090 & = & 11 & + & 7 & \text{mult} & \text{by} & 3 & \text{produce} & 3270 & = & 33 & + & 21 \\ \text{and} & 420 & = & 4 & + & 3 & & & 7 & & 2940 & = & 28 & + & 21 \\ \hline & & & & & & & & & \text{Rems.} & d330 & = & 5 & & Cr. \end{array}$$

and conſequently the $\frac{1}{5}$ of 330*d* = 5*s* 6*d* muſt be the value of a Crown, and as 4 Crowns and 3 Dollars are equal to 35*s*, therefore, from that ſum deduct 22*s* the value of 4 Crowns, and the remainder will be 13*s* the value of 3 Dollars, whence 4*s* 4*d* (the $\frac{1}{3}$ of 13*s*) muſt be the value of a Dollar.

ALLI-

ALLIGATION.

BY *Alligation* you may find,
When sev'ral simples are combin'd;
Or mix'd together so to be,
Just of a middle quality.

CASE I.

When you are to resolve a Question in ALLIGATION MEDIAL *which teaches how to find the* mean rate *of a mixture, when each* particular quantity *and* their several rates *are given, observe the following*

RULE.

Take care at first to multiply
The quantities o'th' mixture by
Their price respective, and divide
The sum o'th' products next, (beside)
By th' sum o'th' quantities you'll see
The quotient the mean rate will be.

EXAMPLE I.

Admit a Farmer would mix 20 Bushels of Wheat at 6*s* 8*d per* Bushel, with 36 Bushels of Rye at 4*s* 4*d per* Bushel. What would a Bushel of this Mixture be worth?

		s d		*£ s d*	
20	×	6 8	=	6 13 4	the value of the 20 Bush. of Wheat
36		4 4		7 16 –	the value of the 36 Bush. of Rye
Sum 56		56 { 7)		14 9 4	the value of the whole Mixture
		8)		2 1 4	the value of 8 Bushels of the Mixture
		Answer		*s* 5 2*d*	the value of 1 Bushel of the Mixture

EXAM-

EXAMPLE 2.

Fat *Toby* well known for a merry old blade,
When cracking his jests at his fuddling trade,
Mix'd a cask of four diff'rent sorts of strong beer,
Whose prices will quickly be made to appear;
Twelve gallons at sixteen pence * first he drew out, * *per gal.*
Next nine gallons more of the beer he call'd *Stout*,
Which was charg'd at two shillings *per* gallon not less,
The value of which you may easily guess.
Next ten gallons more at the rate † here subjoin'd, † 18 *d* *per gal.*
And six of the liquor which pleased his mind,
Whose rate in the margin § you also may find. § 20 *d* *per gal.*
Now how much *per* gallon must th' liquor be sold
To *John*, *Ralph* or *Simon*, be pleas'd to unfold?

$$\left.\begin{matrix}12\\9\\10\\6\end{matrix}\right\}\times\left\{\begin{matrix}\overset{d}{16}\\24\\18\\20\end{matrix}\right\}=\left\{\begin{matrix}\overset{d}{192}\\216\\180\\120\end{matrix}\right\}\text{the value of}\left\{\text{the}\left\}\begin{matrix}12\\9\\10\\6\end{matrix}\right\{\text{Gallons}\right.\right.$$

$$\text{Sum } 37 \qquad 37)708 \quad \text{the value of the whole Mixture.}$$

$$\text{Answer } d\,19\tfrac{5}{37} \quad \text{1 Gal. of the Mixture.}$$

CASE 2.

When you are to resolve a Question in ALLIGATION ALTERNATE, (*which is the reverse of* Alligation Medial *and consequently may be proved thereby*) *observe the following*

RULE.

The rates o'th simples, fair to sight,
In a column under each *one* write;
And the mean rate before let stand
Just opposite on the left hand.

LI The

The sev'ral rates must linked be,
One greater than the *mean* you see
To *one* or any numb'r of less,
Or otherwise, just the reverse;
One less than the *compound one*, you
Link to a greater,—*Tyro*, true,
Or any number * in your view.
To take the diff'rence now prepare,
O'th' mean and rates whate'er they are,
Which opposite the rates you find,
Are link'd, or variously combin'd.

* of greater rates.

Note. It is plain from the abovementioned rule (as well as from an *algebraic* process from whence the Rule is derived) that all Questions of this Case are indeterminate and admit of various Answers, except such Questions that have but one Rate each, either greater or less than the mean, for such a Question will only admit of one way of linking, and consequently (by the *Rule*) will have but one Answer, tho' all Numbers that bear the same proportion between themselves as those that compose the Answer will also satisfy the condition of the Question, so that after one or more Answers are obtained by the Rule, you may find as many more as you please by increasing or decreasing the quantities in any proportion; or by only increasing or decreasing the quantities of any one or more *single* pairs of yoke-fellows in any proportion, and leaving the others as they are.

EXAMPLE I.

A Grocer wou'd mix Sugar at 11*d*, 6*d* and 5*d* per pound, so that the Composition may be worth 7*d* per pound. What quantity of each must be taken?

	d		lb		*d*
d	11	2, 1	3		11
7	6	4	4	at	6
	5	4	4		5

Having first linked the several Rates agreeable to the Rule in

in the preceding *page*, (whereby it is plain that these Rates will admit but of this one way of linking) then the difference between 5 and 7 *viz.* 2 is placed against 11 its yoke-fellow, the difference between 6 and 7 is 1 which is also placed against 11 its yoke-fellow, and the difference between 7 and 11 is 4 which, because it has two yoke-fellows is placed against them both *viz.* against 6 and 5, so that as oft as the Grocer takes 3 lb at 11*d* a pound, he must take 4 lb of each of the other two sorts to make up the Mixture.

EXAMPLE 2.

Old *Merry* the Miller, won'd mix as we find,
What Corn you observe in the margin * subjoin'd,
How much of each sort will exactly agree
To be sold at five shillings *per* bushel tell me?

$$\left.\begin{array}{l}\text{* Wheat}\\ \text{Rye}\\ \text{Beans}\\ \text{Barley}\end{array}\right\}\text{at}\left\{\begin{array}{cc}s & d\\ 6 & 8\\ 5 & 6\\ 4 & 4\\ 3 & 8\end{array}\right\}=\left\{\begin{array}{c}d\\ 80\\ 66\\ 52\\ 44\end{array}\right\}\textit{per}\ \text{Bushel}$$

$$\begin{array}{c}d\\ 60\end{array}\left\{\begin{array}{ll} & d\\ \text{Wheat} & 80\\ \text{Rye} & 66\\ \text{Beans} & 52\\ \text{Barley} & 44\end{array}\right.\left|\begin{array}{c} \\ 16\\ 8\\ 6\\ 20\end{array}\right\}\text{Bushels of}\left\{\begin{array}{l}\text{Wheat}\\ \text{Rye}\\ \text{Beans}\\ \text{Barley}\end{array}\right.$$

The several Rates being linked together, then the difference between 44 and 60 *viz.* 16, is placed against 80 its yoke-fellow, the difference between 52 and 60 which is 8, is placed against 66 its yoke-fellow, the difference between 60 and 66 is 6, which is placed against 52 its yoke-fellow, and the difference between 60 and 80 is 20, which is placed against 44 its yoke-fellow, so that 16 Bushels of Wheat, 8 of Rye, 6 of Beans, and 20 of Barley at the respective prices above-mentioned will compose the Mixture required. *Or*, if you

you were desirous to make up a less Mixture than the above, as suppose a quarter part, then divide the several differences or quantities by 4 and the Answer will be 4 Bushels of Wheat, 2 of Rye, $1\frac{1}{2}$ of Beans, and 5 of Barley, which numbers being in the same proportion between themselves as the abovementioned differences are, will therefore compose the required Mixture.

d			d
60	Wheat	80	8
	Rye	66	16
	Beans	52	20
	Barley	44	6

OR, if 80 and 52 be linked together, and 66 and 44, and the differences placed respectively, the Answer (you see) will be 8 Bushels of Wheat, 16 of Rye, 20 of Beans and 6 of Barley. *Or*, suppose you wou'd have twice as much Wheat in the Mixture as this way of linking the Rates produces, and but $\frac{1}{8}$ part of the Rye, then (according to the *Note* in *page* 398) double the quantity of Beans as well as the Wheat (their prices being yoke-fellows) and also take as well $\frac{1}{8}$ part of the Barley as the Rye (they being yoke-fellows) and the Answer will be 16 Bushels of Wheat, 2 of Rye, 40 of Beans and 3 Pecks of Barley.

d			d	
60	Wheat	80	16,8	24
	Rye	66	16	16
	Beans	52	20	20
	Barley	44	6,20	26

AGAIN, if 80 be linked both with 52 and 44, and 66 with 44, and the differences placed respectively, the Answer (you see) will then be 24 Bushels of Wheat, 16 of Rye, 20 of Beans and 26 of Barley.

d			d	
60	Wheat	80	16, 8	24
	Rye	66	16, 8	24
	Beans	52	6, 20	26
	Barley	44	6, 20	26

ALSO, if 80 be linked both with 52 and 44, and 66 both with 52 and 44 and the differences placed respectively (remembering that if any Rate have two yoke-fellows it will have two differences)

differences) the Anſwer (by this way of linking) will be 24 buſhels of Wheat, 24 of Rye, 26 of Beans and 26 of Barley, and that all theſe different Anſwers will compoſe the Mixture required is eaſily proved by *Caſe* 1 of this Rule, and thus you ſee innumerable Anſwers to any Queſtion of this kind may be eaſily obtained.—There are other ways of linking the Rates of this Example, but theſe already given are quite ſufficient to ſhew the method, and as I have been ſo copious in explaining this Example, I ſhall therefore in each of the following *ones* in this Rule that will admit of being variouſly linked, ſhew but one way and conſequently obtain but one Anſwer thereto.

Case 3.

When you are to reſolve a Queſtion in Alligation Partial, *viz. where one of the quantities to be mixed is given, obſerve the following* Rule.

As th' difference that's ſtanding fair,
Againſt the price o'th' given ware
Or quantity, whate'er it be,
Is to the given quantity;
So are the other diff'rences,
To the reſpective quantities.

Example 1.

Admit a Miller wou'd mix 20 Buſhels of Wheat at 5*s* 6*d per* Buſhel, with Rye at 4*s* and Barley at 3*s*, and would ſell the ſame out again at 4*s* 6*d per* Buſhel.—How much Rye and Barley muſt he take?

		d		
d	Wheat	66	18,6	24
54	Rye	48	12	12
	Barley	36	12	12

As 24 : 20 :: 12 : 10 Buſh. of Rye to be mix'd with
As 24 : 20 :: 12 : 10 Buſh. of Barley the 20 of Wheat.

Note. All Examples that belong to *this* and the following *Caſe* may be eaſily proved by the Rule in *page* 396, *viz. Alligation Medial.*

Example 2.

What quantity of Gold at 15, 16 and 18 Caracts fine, must be mixed with 80 *oz.* of pure Gold *viz.* such as is 24 Caracts fine, so that the Composition may be 20 Caracts fine?

20	24	4,5,2	11 oz.	
	18	4	4	oz. oz. oz. oz.
	15	4	4	As 11 : 80 :: 4 : $29\frac{1}{11}$ of 15, 16,
	16	4	4	and 18 Caracts fine, Answer.

Case 4.

When you are to resolve a Question in Alligation Total, i. e. *when the* Total Sum of the Quantities *to be mixt is given, observe the following*

Rule.

As th' sum of th' differences say,
To th' given quantities alway,
So every diff'rence will be,
To its respective quantity.

Example 1.

Suppose a Grocer would mix 3 sorts of Sugar at 6*d*, 8*d* and 10*d per* lb to have a quantity of 1 Cwt. and would sell it out at 7*d per* lb. How much of each sort must he take?

	d		lb		lb	lb		*d*	
7	10	1	1	lb lb	1	$18\frac{2}{3}$	the Qty.	10	per lb
	8	1	1	As 6 : 112 ::	1	$18\frac{2}{3}$		8	
	6	1,3	4		4	$74\frac{2}{3}$		6	
		Sum	6			112	wh. Qty.		

lb. *d* lb. *d*

Proof. As 112 : 784 the value of the Mixture :: 1 : 7 the mean price given.

Note. It is very obvious from the *Rule* in *page* 397 that the rates in *this* and the two next *preceding Examples* will admit of being linked in no other manner than as they are.

Exam-

Example 2.

Suppose I was to mix up a canister of Tea to contain 30 lb of 5 different prices, *viz.* of 4*s*, 5*s*, 7*s* 9*s* and 10*s* *per* lb, so as to make the Mixture worth 8*s* *per* lb. How much of each sort must I take?

	s		lb		lb	lb	*s*
	10	4	4		4	10	10
s	9	3.1	4	lb. lb.	4	10	9
8	7	1	1	As 12 : 30 ::	1 :	$2\frac{1}{2}$	7
	5	1	1		1	$2\frac{1}{2}$	5
	4	2	2		2	5	4
		Sum	12			30	

the Quantity at 10, 9, 7, 5, 4 *per* lb. wh. Qty.

Promiscuous Questions.

Question 1. by Mr. *James Hardy*.

A Hogshead of Wine that cost 15 Guineas, was lowered with Water, so that the Mixture at 4*s* 6*d* *per* Gallon would just fetch the price of the Hogshead. What quantity of Water was added?

s *d* *Gal.* £ *s*

As 4 6 : 1 :: 15 15 : 70 Gallons, from which deduct 63 (the number of Gallons in a Hogshead) and there will remain 7 Gallons, the quantity of Water that was added.

Question 2 by Mr. *Edward Cocker*.

A Goldsmith hath Gold of 4 several sorts of fineness, *viz.* of 24 Caracts fine, and of 22 Caracts fine, of 20 Caracts fine, and of 15 Caracts fine, and he would mingle so much of each with Alloy, that the whole Mass of 28 Ounces of Gold so mingled may

bear

bear 17 Caracts fine. I demand how much of each he must take?

	24	17	17
	22	2	2
17	20	2	2
	15	3,5	8
	0	7	7
		Sum	36

		oz.		oz.		
		17		$13\frac{2}{9}$		24
oz	oz	2		$1\frac{5}{9}$		22
As 36 :	28 ::	2	:	$1\frac{5}{9}$	the Quantity of	20 Car. fine.
		8		$6\frac{2}{9}$		15
		7		$5\frac{4}{9}$		Alloy
				28		wh. qty.

Note. In Mixtures it sometimes happens (as above) that one ingredient bears no value but is used only to increase the quantity or diminish its worth, and therefore must be represented by a cypher, as Water mix'd with Wine, Copper or other Alloy with Gold or Silver.

ARITHMETICAL PROGRESSION.

THIS *Rule* directs you very fair,
When any ranks of numbers are
Increasing or decreasing by
A common diff'rence low or high.

A *Series of Progressionals* (or as some call 'em *Arithmetical Proportionals*) is a rank of numbers (above two) that follow each other increasing or decreasing regularly by a *Common Difference.*

Hence

1, 2, 3, 4, 5, 6	is a Rank or Series of Progressionals	increasing	by the Common Difference 1
6, 5, 4, 3, 2, 1		decreasing	1
1, 3, 5, 7, 9, 11 and		increasing	2
30, 25, 20, 15, 10, 5		decreasing	5

The

The *Numbers* that compose a *Rank* or *Series* of *Progressionals* are called its *Terms*, whereof the *first* and *last* are called *Extremes*, and any two equally distant from them *Means*.——Now when the Number of the Terms is even, the *Sum* of the *Extremes* is *equal* to the *Sum* of *any two Means* that are at equal distance from such *Extremes* thus, in the Series 3, 4, 5, 6. *the Sum of the Extremes* 3 and 6, is equal to *the Sum of the Means* 4 and 5.——And if the Number of Terms in the *Series* be odd, *twice the middle Term* or *Mean* is always equal to *the Sum of the Extremes*, so in this Series 4, 10, 16, 22, 28, *the double of the Mean* 16 *is equal* to *the Sum of the Extremes* 4 and 28.

There are 5 things to be observed in *Arithmetical Progression*, viz.

1.	The	first	Term commonly the	least
2.		last		greatest
3.		Number of Terms		
4.		Common Excess	or	Difference
5.		Aggregate		Sum of all the Terms

Any three of these being given the other two may be easily found.

PROPOSITION I.

When the first Term, Number of Terms *and* Common Excess *are given to find the* last term.

RULE.

The Common difference subtract
From th' number of Terms (to be exact)
When multipli'd by th' common excess,
Let it be more, or be it less,
Th' remainder added to th' first Term,
Will give the last I can affirm.

Or, Multiply the Number of Terms *minus* Unity by the Common Excess, to the Product add the first Term, and the Sum will be the last Term.

EXAM-

EXAMPLE.

What is the last Term of an *Arithmetical Progression* or *Series* beginning at 4 and continuing by the increase of 2 to 60 places?

First $60 \times 2 = 120$, and $120 - 2 = 118$ *Then* $118 + 4 = 122$ the last Term required.

PROPOSITION 2.

When the first *and* last Terms (*viz.* the two Extremes) *and* Number of Terms *are given to find the* Sum of all the Terms or Series.

RULE.

The Sum o'th' Extremes multiply
Into half the Number of Terms that's by
And th' answer quickly you'll descry

EXAMPLE 1.

How many Strokes does the Hammer of a Clock strike in 12 Hours?

$1 + 12 = 13$ the Sum of the Extremes
6 half the Number of Terms

Answer 78 Strokes.

Or,

$\frac{1+12}{2} = 6.5$
12
78 Ans.

$1 + 12 = 13$
12
2)156
78 Ans.

EXAMPLE 2.

Near *Newhall* mill was lately made
A wager by a *Taylor*,

One

One hundred Stones to gather up,
  As told me by a *Sailor.*
To do the feat he was allow'd
  In minutes *Forty-five*,
Just *Johnny Wilkes*'s number fair,
  'Tis true as I'm alive.
Right in a line the Stones were plac'd
  Exact a yard asunder,
How many miles then did he run,
  To gather up that number? *
And tell me *Tyro* if you please,
  From what is here subjoin'd †
Exact the time the *Taylor* run
  To please his anx'ous mind

It's very plain from the Question that twice the Sum of the Series, whose first Term and Common Difference are 1, and number of Terms 100 will be the Distance required, therefore

$$\overline{1+100}\times 100 = \overset{Yds.}{10100} = \overset{Miles}{5\tfrac{3}{4}} \text{ wanting } \overset{Yds.}{20}$$

And *then* As $\overset{Yds}{252},\ \overset{F.}{1\tfrac{1}{4}} : \overset{Min.}{1} :: \overset{Yds.}{10100} : \overset{Minutes}{40\tfrac{40}{3029}}$

the $\left\{\begin{array}{l}\text{Dist.}\\ \text{Time}\end{array}\right\}$ ran.

PROPOSITION 3.

When the first Term, Number of Terms *and* Common Excess *are given to find the* Sum of all the Terms or Series.

RULE.

Th' Number of Terms by th' common Excess
Multiply,—and th' Product make less
By th' common Difference, and to
What's left, add twice th' first Term also.
Then half of that Sum multiply
By th' Number of Terms and you'll espy
The Sum of all,—the Series true,
As underneath I'll quickly shew.

---

* *i. e.* To gather them singly and put them into a Basket. † 252 Yds. 1 Ft. 3 Inches *per* Minute.

EXAM-

EXAMPLE.

Suppose I agree with a Pump-maker to sink a Well 20 Yards deep and am to pay him 1*s* for the first Yard, 3*s* for the second, 5*s* for the third, and so on raising 2*s* every Yard. What will the whole amount to?

The Number of Terms multipli'd by the common Difference produces 40, from which deduct 2 the common Difference or Excess, and the remainder will be 38, which add to twice the first Term *viz.* 2 and the sum will be 40, half of which is 20, which multiplied by 20 the Number of Terms produce 400 Shillings = £20 the Answer.——*Or*, If you add the abovementioned Remainder 38 to the first Term only, according to *Proposition* 1, *page* 405, (and not to the double of the first Term) the Sum will be 39 the last Term, and then there will be given the first Term, last Term, and Number of Terms as in the preceding *Proposition*, *page* 406, to find the Sum of the Series and therefore the Remainder 38 being added (as above) to twice the first Term gives the Sum of the Extremes and consequently by any of the methods in the said next *preceding Proposition* the Answer will be easily found to be £20 as above.

Note. When the first Term and common Difference of any Arithmetical Series are each of them an Unit, then it is plain from the first mentioned Series in *page* 404, that the Number of Terms and last Term of such Series will always be equal to each other, as in *Example* 1 *page* 406, for the first Term and common Difference being each an Unit, therefore the Number of Terms and last Term are both equal *viz* 12.—But if either the first Term or common Difference in any ascending Arithmetical Series be more than an Unit, then the last Term thereof will always be greater than its Number of Terms as in the *Exam-*

ple

ple in this *Proposition* the number of terms is 20 but as the common difference is greater than an Unit *viz.* 2, therefore 39 is the last term as is easily found by *Proposition* 1 in *page* 405.

PROPOSITION 4.

When the first *and* last Terms *viz. the* two Extremes, *and* Number of Terms *are given to find the* Common Difference *or* Excess.

RULE.

The Diff'rence of the two extremes,
Divide by the number of Terms
Less one—and the Quotient will be,
The common Diff'rence you will see.

EXAMPLE.

A *Cooper* who loved to smoke and to drink,
A Debt had to pay but was short of the *chink*,
In Arithmetical Progression agreed for to pay
The Sum at twelve diff'rent payments they say,
Th' first payment two Shillings the last just a score,
The whole Debt young *Tyro* with ease you'll explore
And what was the Sum of each payment agreed
By the *Cooper* to pay?—Come tell me with speed.

From 20 the greater Extreme take 2 the less Extreme and the remainder will be 18 which divide by 11 *viz.* the number of Terms less 1, and the Quotient will be $1s\ \frac{7}{11} = 1s\ 7d\ \frac{1}{2}\ \frac{6}{11}$ the common Excess or Increase, which add to each payment and the whole Debt will be found to be £6 12*s* as is also plain from either of the two *Propositions* in *pages* 406 and 407.

PROPOSITION 5.

When the first *and* last Terms *viz. the* two Extremes *and* Common Excess *are given to find the* Number of Terms.

RULE.

The Diff'rence o'th' Extremes divide
By th' common Excess, to th' Quote beside
Add Unity,—the Sum will be
Th' number of Terms as you will see.

EXAMPLE.

Admit a Man was to go a journey and his first day's travel to be 6 Miles and the last 60, every day encreasing his journey by 4 Miles. How many days would he be in compleating the same.

First 60—6=54 the Difference of the Extremes *Then* divide 54 by 4 the Common Excess, and the Quotient will be $13\frac{1}{2}$, to which add 1 and the Sum will be $14\frac{1}{2}$ days the Answer.

PROPOSITION 6.

When the last Term, Number of Terms *and* Common Excess *are given to find the* first Term.

RULE.

Th' common Excess first multiply
By the number of terms less unity,
The product from th' last Term subtract,
And the Result's the first in fact.

EXAMPLE.

A Gentleman to bestow his Charity takes out of his Pocket a certain number of halfpence which he gives to 12 poor persons, every one receiving 3 more than the former. What had the first when the last receiv'd two Shillings and what was the Sum the Gentleman bestow'd?

First

First The number of Terms leſs 1 *viz.* 11 multipli'd by 3 the common Exceſs produces 33 which deduct from 48 the halfpence in 2*s* and the remainder will be 15 halfpence=7*d*$\frac{1}{2}$ the ſum the firſt perſon receiv'd *Then* by *Propoſition* 2, *page* 406, or by *Propoſition* 3, *page* 407; it may be eaſily known that 15*s* 9*d*. was the whole ſum that the Gentleman gave away.

PROPOSITION 7.

When the Number of Terms, Common Exceſs *and* Sum of all the Series *are given to find the* firſt Term.

RULE.

The ſum of all the Terms divide
By th' number of Terms, and beſide
From the Quotient, ſubtract (not leſs
Than) half th' product of th' common Exceſs
Into th' number of Terms leſs Unity,
Th' remainder will the firſt Term be.

EXAMPLE

Humbly addreſs'd to all ingenious young Ladies.

Near *Nantwich* town now lives a charming *Fair*,
Thither ye blooming Maids in haſte repair,
There learn the force of Wit and Beauty's Charms,
And Virtue hourly guarding her from Harms,
There learn t' admire ſuperior Reaſon Senſe,
The pow'r of Wiſdom and of Eloquence!
All you can wiſh in this bright Maid combine,
To make her lovely and appear divine!
Well vers'd in figures is this charming Maid,
Minerva ſmiling gives her all her Aid,
Inſtructs the *Fair* as *Damon* well can prove,
Such heav'nly pow'rs make Man do more than love.

Ye brill'ant *Fair* who with this Maid can vie,
Learn from her precepts, imitate and try
To work th' Example which the *Swain* did poze,
The task is nothing to the fairest Muse.

QUESTION.

This amiable *fair One*, being in company with a very agreeable young Gentleman, told him that in $2\frac{1}{2}$ years she shou'd receive the whole of her fortune, which was £1000. that next quarter's day she shou'd receive the first payment and each payment after wou'd exceed the former by £20. "Now Sir" (says she, smiling on the young Gentleman) "I am free to give you the first payment, provided, you will tell me what it is from the given *Data*", but the young Gentleman being unskill'd in numbers cou'd not comply to her proposal, but leaves it to the study of the *fair-sex* to resolve the Question, and tell him the first payment.

First divide 1000 the Sum of the Series, by 10 the number of Terms *i e* the Quarters in $2\frac{1}{2}$ years and the Quotient will be 100. *Then* from 10 deduct 1 and the remainder will be 9 which multiplied by 20 the common Excess will produce 180, half whereof is 90 which deduct from the above mentioned Quotient 100, and the remainder will be £.10 the Answer.

Or multiply the number of Terms by the common Difference, and that product by the number of Terms less an Unit, subtract the last product from twice the Sum of the series and divide the remainder by twice the number of terms; and the Quotient will be the least Term.

See the Work.

From $1000 \times 2 = 2000$
Take $10 \times 20 \times 9 = 1800$
Divisor $10 \times 2 = 20)\ 200$
£10 the Answer as above.

PRO-

PROPOSITION 8.

When one person *or* thing moves *with an* equal *and another the same way by a* progressive motion, *to find in what time* the first will be overtaken.

RULE.

To twice the space gone o'er each day
By the pursu'd, mind what I say
Add th' common Excess, be what it will
O'th' pursuer's days journey, mind me still,
From th' Sum take twice the space gone o'er
By the pursuer the first day——more
Divide th' result by th' common Excess
Th' Quote will th' number of days express
As the pursu'd will be o'erta'en
As quickly now I shall explain.

EXAMPLE

Suppose a Highwayman (such as the late noted *Turpin*) committed a Robbery and suspecting a pursuit rode off at the rate of 40 miles a day, now suppose a Thieftaker follow'd him in a progressive motion and rode 30 miles the first day, 34 the next and so on encreasing 4 miles every day. In how many days wou'd the Highwayman be overtaken?

First, 40 multipli'd by 2 produces 80 to which add 4 the common Excess and the Sum will be 84. *Then* from 84 deduct 60 *viz.* twice the Space the Pursuer was supposed to ride the first day, and the remainder will be 24 which divided by 4 (the common Excess) quotes 6 the answer, as may be easily proved, for $6\times40=240$ which by *Proposition* 3, *page* 407, will be readily found to be the Sum of *that Series* whose first Term is 30, Number of Terms 6, and Common Excess 4, and therefore proves the above work to be right.

GEOMETRICAL PROGRESSION.

GEOMETRICAL PROGRESSION ſhews
When Ranks of Numbers we ſuppoſe
T' increaſe by equal Ratios—or
Decreaſe the ſame in Number,—for
Common Multipliers plainly ſhew
And Diviſors too—the Ratio.

A *Series* of *Proportional Numbers*, or *Proportionals* (by ſome called *Geometrical Proportionals*) is a Rank of Numbers (above two) that ſucceed each other increaſing or decreaſing regularly by a *Common Multiplier* or *Diviſor*.

Hence

1, 3, 9, 27, 81	is a Rank or Series of Proportionals	inc.	by the Common	*Mult.* 3
81, 27, 9, 3, 1		dec.		*Div.* 3
2, 8, 32, 128, 512 and		inc.		*Mult.* 4
625, 125, 25, 5, 1		dec.		*Div.* 5

In any rank of Numbers in *Geometrical Progreſſion*, the *firſt* and *laſt Terms* are call'd *Extremes* and any *two equally diſtant* from them *Means* the ſame as in *Arithmetical Progreſſion* ſee *page* 405. Now when the Number of Terms of any *Geometrical Series* is even, it is plain that the *product* of the *Extremes* is always *equal* to *that* of every *two Means that are equally diſtant from them*, as in the Series

4, 8, 16, 32, is *equal* to the *product* ariſing from the *Extremes* 4 and 32 *viz.* 128; *Means* 8 and 16.—And if the Number of Terms of any *Geometrical Series* be odd, then the *Square* of the *Mean* or *middle Term* is always *equal* to the *Product* of the *two Extremes* or to

to *that* of any *two Means equally distant* from the *Mean* or *middle Term*, as in the Series 3, 12, 48, 192, 768 the *Square* of 48 the *Mean viz.* 2304 is *equal* or to the *Prod.* arising from the 2 *Extrs.* 3 and 768, *Means* 12 and 192

There are 5 things to be observed in a *Geometrical Series* (as well as an *Arithmetical One*) *viz.*

1. The first Term commonly the least
2. The last Term commonly the greatest
3. The Number of Terms
4. The Ratio
5. The Aggregate or Sum of all the Terms.

Any three of these being given the other two may be easily found.

PROPOSITION I.

When Unity is the first Term, *and the* Ratio *and* Number of Terms *are given to find the* last Term *without producing all the intermediate Terms.*

RULE.

A few of the leading Terms first find,
O'er which place th' Indices † to your mind.
Then find what figures of the Indices,
When added together true, that is, —
Will give th' Index o' th' Term that's sought,
Then multiply the Numbers wrote
Under such Indices, into
Each other, and the Product 'll shew
The Term requir'd, as soon you'll know.

Note. You must take care to remember that the Sum of the Indices is always 1 less than the Number

† Indices or Exponents are a Series of natural Numbers which proceed from Unity or 1, and shew the places of the Terms of the Progression.

of

of Terms, because the Indices begin with a Cypher, and therefore

The Index $\left\{\begin{matrix}1\\2\\3\\4\\\&c.\end{matrix}\right\}$ always stands over, and consequently denotes the $\left\{\begin{matrix}2d\\3d\\4th\\5th\\\&c.\end{matrix}\right\}$ Term, as is manifest in all the Examples in *this* and the two following *Propositions*.

EXAMPLE.

Once *Country Ralph* a Horse did buy,
'Twas of a Sharper *Obed Sly*,
And by agreement was to pay,
What the last Nail came to they say,
A Farthing for the first Nail he
Agreed to pay, th' second must be
Doubled,—so on to th' Number eight. †
Come *Tyro* now you'll tell me straight,
What *Ralph* was t' pay—the Sharper's claim
This do, and mount aloft to *Fame*.

† 4 Shoes and 8 Nails in each.

First $\left\{\begin{matrix}0, & 1, & 2, & 3, & 4, & 5, & 6, & 7, & 8 & \text{Indices or Exponents}\\ 1, & 2, & 4, & 8, & 16, & 32, & 64, & 128, & 256 & \text{Terms}\end{matrix}\right.$

and $\left\{\begin{matrix}7 + 7 = 14\\ 128 \times 128 = 16384\end{matrix}\right.$ the 14th Index or Exponent and consequently the 15th Term.

Then $\left\{\begin{matrix}14 + 14 = 28\\ 16384 \times 16384 = 268435456\end{matrix}\right.$

$$\begin{array}{r}268435456\\ 8\\ \hline 2147483648\\ \hline\end{array}$$

the $\left\{\begin{matrix}28th\\3d\\31st\end{matrix}\right\}$ Index, and consequently the $\left\{\begin{matrix}29th\\4th\\32d\end{matrix}\right\}$ Term.

Or

Or thus

$$\textit{First}\begin{cases}7+8=15\\128\times256=32768\end{cases}$$

$$\left.\begin{array}{r}32768\\2\\\hline 65536\\\hline\end{array}\right\}\text{the}\left\{\begin{array}{c}15\text{th}\\1\text{ft}\\16\text{th}\end{array}\right\}\text{Index, and confequently the}\left\{\begin{array}{c}16\text{th}\\2\text{d}\\17\text{th}\end{array}\right\}\text{Term.}$$

$$\textit{Then}\begin{cases}15+16=31\\32768\times65536=2147483648\end{cases}$$

the fame as in the preceding *page* being the 32d, or laft Term in Farthings, which make £2236962 2*s* 8*d* the price of the Horfe or laft Nail.

Too much by far, for honeft *Ralph* to pay,
Who fhou'd take care of Sharpers in this way,
An honeft man may eafily be undone,
By giving way to fuch a Sharper's Pun.

Note. The abovementioned fum of £2236962 2*s* 8*d* you fee is only the price of the laft Nail, but the Sum of the Terms *viz* What all the 32 Nails will amount to, may be eafily known by *Propofition* the 3d in *page* 418 to be 4294967295 Farthings = £4473924 5*s* 3*d* $\frac{3}{4}$.

PROPOSITION 2.

When the firft Term *of any Geometrical Series is* greater than Unity, *and* that Term, *the* Number of Terms *and* Ratio *are given to find the* laft Term *without producing all the intermediate Terms.*

RULE.

Here as in Rule the laft proceed,
Only in this, you muft take heed,
Ev'ry Product muft divided be
By the firft Term, the Quote you'll fee,
Will with the Term requir'd agree.

EXAM-

EXAMPLE.

Suppose a person had 9 Sons and leaves the youngest £100, the next as much and half as much, and so every Son to exceed the next younger by the equal Ratio of 1 ½. What is the eldest Son's share?

First	0,	1,	2,	3,	4	Indices
	100,	150,	225,	337.5,	506.25	Terms

and $\begin{cases} 4 \quad + \quad 4 \\ 506.25 \times 506.25 = 256289.0625. \end{cases}$

Then divide 256289.0625 by 100 the first Term and the Quotient will be 2562.890625 = £2562 17s 9d¾ the Answer.

PROPOSITION 3.

When the first Term, Number of Terms *and* Ratio *are given to find the* Sum of all the Terms *or* Series.

RULE.

Now find the last Term as before,
From which deduct the first, not more,
Th' remainder by th' Ratio divide
Less one — And to that Quote beside,
Add the last Term, and you will find
The Sum required to your mind.

Hence it is plain that in any finite Geometrical Progression it holds

As	the	Ratio *minus* Unity	is to	Unity	so is
Or, As	the	Diff. o'th' 2 greatest Terms	is to	the greatest	so is

the $\begin{cases} \text{Diff. of the greatest and least Terms.} \\ \text{greatest } minus \text{ the least} \end{cases}$ to the Sum of all except the $\begin{cases} \text{greatest.} \\ \text{least.} \end{cases}$

EXAM-

EXAMPLE 1.

Fair *Chloe*'s married to a 'Squire,
Who does her beauteous form admire.
Her Father whimsical inclin'd,
His Daughter portion'd thus we find,
Ten Shillings on the wedding Day,
And doubled ev'ry Month they say,
For one whole Year, what was the Sum?
Come *Tyro* work, the Answer'll come.

First $\begin{cases} 0, & 1, & 2, & 3, & 4, & 5, & 6 \text{ Indices} \\ 10, & 20, & 40, & 80, & 160, & 320, & 640 \text{ Terms} \end{cases}$

and $\begin{cases} 5 + 6 \\ 320 \times 640 = 204800 \end{cases}$ *Then* divide 204800 by the first Term 10, and the Quotient will be 20480 the last Term, from which deduct the first Term and (as the Ratio *minus* Unity is just an Unit, therefore) to the remainder 20470 add 20480 the last Term, and the Sum will be 40950 Shillings = £ 2047 10s the Ans.

Or, according to the first mentioned *Analogy* in the preceding *page*. As the Ratio *minus* Unity *viz*. 1 is to Unity or 1 so is 20470 the Difference of the greatest and least Terms, to 20470 the Sum of all except the greatest, *Hence* is manifest this

COROLLARY

That if the Ratio of any Rank or Series of Proportionals be double, the Difference of the greatest and least Terms is equal to the Sum of all except the greatest, if the Ratio be triple, the Excess or Difference is double the Sum of all except as aforesaid, if quadruple, triple, if quintuple, quadruple, and so on.

EXAMPLE 2.

Suppose a Labourer was to agree with a Farmer to thrash his Barley be what Quantity it wou'd for 20 Years, upon condition he wou'd give him 4 Barley Corns for the first Year, 12 for the second, 36 for the third,

third, and ſo on to the end of the 20 Years. What wou'd his Wages amount to allowing 7680 Grains to a Pint, and 64 Pints to the Buſhel and the whole Quantity to be worth 3*s* 10*d* *per* Buſhel?

Firſt $\left\{\begin{array}{l} 0,\ 1,\ 2,\ 3,\ 4,\ 5 \text{ Indices} \\ 4,\ 12,\ 36,\ 108,\ 324,\ 972 \text{ Terms} \end{array}\right.$

and $\left\{\begin{array}{l} 5 + 5 \\ 972 \times 972 = 944784 \text{ which} \end{array}\right.$ divided by 4 the firſt Term quotes 236196 the 10th Index, and conſequently the 11th Term.

Then $\left\{\begin{array}{l} 10 + 10 \\ 236196 \times 236196 = 55788550416 \text{ which} \end{array}\right.$ divided by 4 the firſt Term quotes 13947137604 the 20th Index, and conſequently the 21ſt Term.

and the 21ſt Term *viz.* 13947137604 divided by the Ratio quotes 4649045868 the 19th Index, and conſequently the 20th Term.

Or thus,

Firſt $\left\{\begin{array}{l} 4 + 5 \\ 324 \times 972 = 314928 \text{ which} \end{array}\right.$ divided by 4 the 1ſt Term quotes 78732 the 9th Index, and conſequently the 10th Term.

and $\left\{\begin{array}{l} 9 + 9 \\ 78732 \times 78732 = 6198727824 \text{ which} \end{array}\right.$ divided by 4 the 1ſt Term quotes 1549681956 the 18th Index, and conſequently the 19th Term.

$$\begin{array}{lr} & 1549681956 \\ \text{Ratio} & 3 \\ \hline & 4649045868 \end{array}$$

the 19th Index and conſequently the 20th Term.

Then (according to the *Rule* and also to the *first Analogy* in *page* 418, they being both one and the same in effect) deduct 4 the first or least Term from 4649045868 the last or greatest Term, and divide the remainder 4649045864 by 2 *viz*, the Ratio less 1, and the Quotient will be 2324522932 the Sum of all the Terms except the last or greatest, to which add 4649045868 the last or greatest Term, and the Sum will be 6973568800 the Sum of all the Terms or the whole Number of Barley Corns.

OR, according to the *second Analogy* in *page* 418.

As 4649045868—1549681956 = 3099363912 *viz.* the difference of the 2 greatest Terms, is to 4649045868 the greatest Term, so is 4649045868—4 = 4649045864 *viz.* the greatest Term *minus* the least, to 6973568796 the Sum of all the Terms except the least, to which add 4 the least Term, and the Sum will be 6973568800 the Number of Barley Corns the same as before, which divide by 491520 = $\overline{7680} \times \overline{64}$, and the Quotient will be 14187 $\frac{2341}{3072}$ *viz.* 14187 Bushels and a little more than 3 Pecks, which at 3*s* 10*d* a Bushel amount to £2719 6*s* 5*d* the Answer.

PROPOSITION 4.

When the first Term *and* Ratio *of any* infinite decreasing Geometrical Series *or* infinite Series of decreasing Proportionals *are given to find the* Sum of the Series.

RULE.

Divide the Square o' th' first Term true,
By th' diff'rence, which the first doth shew
And th' second Term i'th' Series too.
This done, the Quotient will appear
The Sum o' th' Series very clear.

A *Geometrical Series* that decreaseth *ad infinitum* or in other words an *Infinite Series* of *decreasing Proportionals* is such whose *last* or *least Term* is a *Cypher* or *less than any thing* assignable, and its *Number of Terms inexpressible*; and that the Sum of *such a Series* whose several Terms are *utterly impossible to be expressed* can be so easily known as is set forth in the *Rule* in the preceding *page*, or indeed known at all! seems *VERY WONDERFUL!* but that it may be so easily done is plain from the *second Analogy* in *p.* 418 *viz.* As the difference of the two greatest Terms, is to the greatest, so is the greatest *minus* the least, to the Sum of all except the least. Now as in an *infinite decreasing Series* the last or least Term is a Cypher (as above) therefore there is nothing to be subtracted from the greatest Term, and consequently in such a Series it must be; As the difference of the two greatest Terms is to the greatest, so is the greatest, to the Sum of all, whence is derived the *Rule* in the preceding *page*.

Or the Sum of such a Series may be known by the following *Analogy, viz.* As the difference of the two first or greatest Terms, is to the second Term, so is the first or greatest Term, to the Sum of all the others *ad infinitum*.

EXAMPLE.

Find the Sum of the Series $\frac{1}{4}$, $\frac{1}{16}$, $\frac{1}{64}$, $\frac{1}{256}$ &c. *ad infinitum*.

First $\frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$, and $\frac{1}{4}$ (*viz.* $\frac{4}{16}$) $- \frac{1}{16} = \frac{3}{16}$.

Then $\frac{3}{16}$) $\frac{1}{16}$ ($\frac{16}{48} = \frac{1}{3}$ the Answer.

Or (according to the last mentioned *Analogy*) As $\frac{3}{16}$ the difference of the two first or greatest Terms, is to $\frac{1}{16}$ the second Term, so is $\frac{1}{4}$ the first or greatest Term, to $\frac{16}{192} = \frac{1}{12}$ the Sum of all the Terms except the first or greatest, to which add $\frac{1}{4}$ the first or greatest, and the Sum will be $\frac{4}{12} = \frac{1}{3}$ the Answer as before.

PRO-

PROMISCUOUS QUESTIONS.

Question 1.

From Mr. *Donn's* Arithmetic, *page* 209.

A Gentleman as he did ride
Near to a pleasant Common side,
Ten Shepherdesses chanc'd to meet,
Driving their Flocks, whom he did greet,
God speed you well; and may you be
As happy as you're fair (said he :)
Prosper your Flocks, and may they thrive;
Tell me how many Sheep you drive?
One of the Damsels straight reply'd,
Sir, you shall soon be satisfy'd.
For if for one of us you do
Count one Sheep, for the next count two,
For the third four, for the fourth eight,
So doubling at each Maid aright,
At the last Maid the Sum will be,
As many as the Sheep you see.

Quere the Number of the Sheep?

First $\begin{cases} 0,\ 1,\ 2,\ 3,\ 4,\ \ 5 & \text{Indices} \\ 1,\ 2,\ 4,\ 8,\ 16,\ 32 & \text{Terms} \end{cases}$

and $\begin{cases} 4\ +5\ =9 \\ 16\times32=512 \text{ the Number of Sheep requir'd.} \end{cases}$

Or thus,

$4\ +3+2=9$

therefore $16\times8\times4=512$ as before, and here we may observe that whatever Indices we take whose Sum is under the last Term, the powers of the Ratio under such Indices multiplied into each other will be equal to the power of the Sum of such Indices or Exponents.

Question 2. by Mr. *John Newbold.*

From Mr. *Tipper*'s Delights for the Ingenious, published in 1711.

Suppose a round Ball for to move in the Air,
In a certain proportion which I shall declare;
Let the first Hour be 12 Miles, the next to move 10,
And so in proportion from whence it began,
As 12 is to 10, now try if you can
Tell the Miles it will move, suppose it to be
Continued in Motion to *ETERNITY!*

First $12 \times 12 = 144$, and $12 - 10 = 2$. *Then* divide 144 Miles by 2 and the Quotient will be 72 Miles the Answer.

Or, As 2 the difference of the two greatest Terms, is to 10 the second Term, so is 12 the first or greatest Term, to 60 Miles the Sum of all the Terms except the first or greatest, to which add 12 Miles the greatest Term, and the Sum will be 72 Miles the Answer the same as above.

PERMUTATION.

THIS *Rule* will shew you instantly,
How th' order of things may varied be,
With respect to place, as you will see.

RULE.

All th' given Series multiply
One into another continually.
Then the last product points out fair
The Answer true I do declare.

EXAM-

Example 1.

At *Whitchurch* we've a Church that's nearly new,
Which beauteous Pile, can be outvi'd by few:
Here ſacred Grandeur, captivates the Eye,
Trav'lers admire the ſame, as they paſs by;
To grace this Structure, there's a lofty Tow'r,
With eight fine Bells, which harmonize each Bow'r.
How many Changes may be rung declare,
On theſe eight Bells, and likewiſe tell me fair,
How long they wou'd be ringing them once o'er,
Allowing eight Seconds *per* Change, not more?

Firſt $1\times2\times3\times4\times5\times6\times7\times8=40320$ the No. of Changes

Then $40320\times8=322560$ Sec. $=89$ Hours and 36 Minutes the time the 40320 Changes wou'd be in ringing once over, admitting 1 Change to be rung in 8 Seconds.

Example 2.

How often might a Family of 12 perſons dine together, and be placed every day in a different Poſition?
$1\times2\times3\times4\times5\times6\times7\times8\times9\times10\times11\times12=479001600$ Days, which (at 365 Days to the Year) are equal to $1312333\frac{11}{73}$ Years the Anſwer.

Scholium.

I ſhall conclude this *Rule* with two Queſtions in *Combinations*, the firſt from *Ladies Diary*, 1711, and the ſecond from Mr. *Birks'* Arithmetic, who gives the following

Rule.

"Having placed the given Quantity by itſelf, de-
"creaſe it gradually by an Unit, ſo often as there are
"quantities in the Combinations; placing them one

 "after

"after another, with a sign of multiplication between "them, which numbers must be multiplied into one "another for a dividend: then placing an Unit "with the like number of places, increasing by Unity 'till you arrive at the Number to be combin'd; "which multiply continually for a Divisor, and the "Quotient will be the Number of Combinations "sought."

Question 1. by Mr. *William Hawney*.

Ladies Diary, 1711.

A famous Gen'ral having serv'd his King,
Who always from the Wars did Vict'ry bring,
For this good Service (with a pleasant smile,)
Ask'd of his King, one farthing for each file
Of ten Men in a file, which he cou'd then
Make with a Body of one hundred Men.
The King, consid'ring his brave Actions past,
And seeming Modesty of his request,
Gave his consent—To what will it amount
In *Sterling* Money? take your Pen and count.

$$\frac{100}{1}\times\frac{99}{2}\times\frac{98}{3}\times\frac{97}{4}\times\frac{96}{5}\times\frac{95}{6}\times\frac{94}{7}\times\frac{93}{8}\times\frac{92}{9}\times\frac{91}{10}=$$

$$\frac{62815650955529472000}{3628800}=17310309456440$$

Farthings, which are equal to 18031572350 £ 9 s 2 d the Answer.

Question 2. by Mr. *Birks*.

In *Lincolnshire*, where bounteous Nature yields
Fat sheep and oxen, and luxuriant fields;
Our gen'rous clime, replete with rosy health,
Choice friends afford, bright, fair, & plenteous wealth.
Some fenny ground have we, with flocks of geese,
Yielding five times a year, their feather'd fleece.

On

On which devoid of care, Swains sleeping lie,
After repast of sav'ry giblet-pye.
One day at *Boston* o'er a jug of ale,
A *Gossard* offer'd all his flock to sale
At fifteen pence a piece, but I propos'd
A diff'rent price, with which he quickly clos'd.
(The geese are mark'd by cutting toe or heel,
The webs are pierc'd or slit with sharpen'd steel.)
An hundred pounds for just as many geese,
As may be diff'rent mark'd: What's that a piece?

As each goose had 3 toes, 2 webs and 1 heel on each foot, there were 12 different things to be mark'd, but as the 4 webs might be either slit or pinched; but not both together, therefore $2\times2\times2\times2\times2\times2\times2\times2=256$ and $3\times3\times3\times3=81$.

Now $256\times81=20736$ } the No. of { Combinations
and $20736-1=20735$ } the No. of { Marks or Geese

	Geese.		£		Goose. d
Then As	20735	:	100	:: 1 :	$1\frac{653}{4147}$ the Answer.

SINGLE POSITION;

Or, the Single *Rule* of *False*.

POSITION is so call'd, because
Uncertain Numbers we suppose
To reason with, and by them gain
True Numbers sought—'tis very plain.

Single Position discovers the truth by one supposed Number, and is wrought by the following

RULE.

Choose your Position, then prepare
To work as if the Number were

The

The true one, and perhaps you'll see
Th' result will not with truth agree,
Then this proportion there must be,
As th' result of your Position's to
The same Position taken,——so
The given Number 'll always be,
Unto the Number sought you'll see.

Example 1.

At a certain School if you add $\frac{1}{2}$, $\frac{1}{4}$ and $\frac{1}{5}$ of the Number of Scholars together the sum will be 76. *Quere* the Number of Scholars?

Suppose the Number of Scholars were 100, then $\frac{1}{2}$ $\frac{1}{4}$ and $\frac{1}{5}$ thereof wou'd be 95 which (by the Question) shou'd have been only 76, therefore

$$\begin{array}{rcccc} & \textit{Sch.} & \textit{Sch.} & \textit{Sch.} & \textit{Sch.} \\ \text{As} & & 100 & 76 & \\ & 95 : & :: & : & 80 \text{ the Answer.} \\ \textit{Or} \text{ As} & & 76 & 100 & \end{array}$$

Example 2.

Near *Marbury* within a Cottage tarry,
Old *Simon* with his Daughters *Ruth* and *Mary*.
The one hath charms to captivate the mind,
The other's handsome, and to love inclin'd,
Oft, though in vain, a neighb'ring *Swain* hath try'd
To gain consent to have one for his bride,
But the morose, old peevish Man won't give
Consent, as long as ever he doth live.
Like Nuns who're in a Nunnery confin'd,
He keeps his Daughters close from all mankind.
All lovers from his house, he makes to run,
With rusty Rapier, Blunderbuss, or Gun.
While *Simon* lives, each Daughter must obey,
Hard Lot! for them, we cannot choose but say.

The

The Father's and the Daughters Age you'll find,
From what you see is underneath subjoin'd, *
Which being found, pity the maidens cause,
Who must obey, a churlish Father's laws.

yrs.
Suppose 20 to be the eldest daugh-ter's Age.
Then (*per* Q.) $20 - 2 = 18$ wou'd be the youngest daugh-ter's Age.
and $20 + 18 = 38$ wou'd be the Father's Age.

The Sum whereof is 76 which (per Question) shou'd have been 124, therefore

yrs yrs yrs yrs.
As 76 : 38 :: 124 : 62 the Father's Age, which being taken from 124 (the sum of all their Ages) leaves 62 the sum of the two Daughter's Ages, and as the one Daughter is 2 years older than the other, consequently 32 and 30 must be their respective Ages.

Example 3.

A person being asked what number of Shillings he had in his pocket, reply'd if I had as many, $\frac{1}{2}$ as many and $\frac{1}{4}$ as many, I shou'd have 275. How many Shillings had he?

Suppose he had 60 Shillings, then as many, $\frac{1}{2}$ as many, and $\frac{1}{4}$ as many wou'd make 165, which (by the Question) shou'd have been 275, therefore

s. s. s. s.
As 165 : 60 :: 275 : 100 the Answer.

* The Father's Age is equal to the Sum of both the Daughter's Ages, the one Daughter is 2 years older than the other, and the Sum of all their Ages is 124.

Exam-

EXAMPLE 4.

An old Woman of above threescore and ten,
Has buried four husbands, and married again
To *Jerry* the Mugman,—a Bagpiper Rare!
And none can with him for his music compare.
The music he play'd pleas'd the old woman much
'Till she hopp'd and she caper'd about without crutch,
Though wrinkled and wither'd—no tooth in her head
Yet money she had and she got married,
To his Bagpipes she mov'd, with one foot in the grave
For all her delight was a husband to have!
The sum of both ages one hundred years are
Wanting five— and one fourth of her Age I declare,
Is the Age of the husband—now *Tyro* you'll find,
The Bagpiper's Age with his Spouse's so kind.

$$\left.\begin{array}{l}\text{Suppose 80 to}\\ \text{Then } (per\ Q.)\ 20 \text{ wou'd}\end{array}\right\}\text{be the}\left\{\begin{array}{l}\text{Wife's}\\ \text{Husband's}\end{array}\right\}\text{Age}$$

The sum whereof is 100 which (by the Question) shou'd have been only 95, therefore

$$\left.\begin{array}{l}\text{As } \overset{yrs}{100} : \overset{yrs}{80} :: \overset{yrs}{95} : \overset{yrs}{76}\\ \text{Then } (per\ Q.)\ \frac{1}{4}76 = 19\end{array}\right\}\text{the}\left\{\begin{array}{l}\text{Wife's}\\ \text{Husband's}\end{array}\right\}\text{Age}$$

PROMISCUOUS QUESTIONS.

Question 1. by Mr. *Charles Hutton.*

A Gentleman distributed 78 pence among a number of poor People, consisting of Men, Women and Children, to each Man he gave 6*d*, to each Woman 4*d*, and to each Child 2*d*, moreover there were twice so many

many Women as Men, and thrice so many Children as Women: How many were there of each?

					d		*d*
Suppose 6 to		would be the No. of	Men	which at	6	each, would receive	36
Then (*per* Q.)	12		Women		4		48
and	36		Children		2		72
					The Sum whereof is		156

but the Sum distributed was only 78*d*, therefore

	d	*Men*	*d*			
As	156 : 6 :: 78 : 3			the No. of		Men
Then (*per* Qu.)	3 × 2 = 6					Women
and	6 × 3 = 18					Children

Note. As it happens that the Result of the Position taken is 156 *viz.* exactly twice as much as the number of Pence distributed, therefore the half of the Supposition 6 *viz.* 3 must be the number of Men reliev-ed.—The Proof of Questions bel nging to this Rule being so very easy that it is unnecessary to say any thing relating thereto.

Question 2. by Mr. *Leybourn.*

See his *Cursus Mathematicus, page* 52.

One delivered into the hands of a Trustee for a Child's Portion, a certain Sum of Money to be paid to the party at the expiration of 10 years with the Profit of the same Sum at £6 *per Cent.* Simple Int. and at the end of the 10 years the party received £450. What was the sum of money that was put into the Trustee's Hands?

Suppose the Principal or Sum delivered to the Trustee was £150, the Interest whereof for 10 years at £6 *per Cent* is £90, which add to £150, and the Sum or Amount will be £240, which (according to the Question) ought to have been £450, therefore

£ £ £ £ *s*
As 240 : 150 :: 450 : 281 5 the Answer.

DOU-

DOUBLE POSITION.

TO work this *Rule*, you'll quickly ſee,
Two ſuppoſitions there muſt be
By means of which the number's found
That's ſought——as quickly I'll expound.

RULE.

Two ſuppoſitions make, and ſee
How with your Queſtion they agree,
By working with them, as if they
Were the true numbers ſought, I ſay—
How much th' *Reſults* are diff'rent find,
From *that* i'th' Queſtion—*Tyro* mind—
Th' diff'rences or errors multiply,
Croſſwiſe the ſuppoſitions by.
Now if the errrors do agree,
That is, if *both the Reſults* ſhall be
Greater or leſs (as you may ſee)
Than is th' *Reſult*, i'th' Queſtion——then
Th' Diff'rence o'th' products is th' dividend,
Which when it is divided true
By *th' Diff'rence* o'th' errors—*Tyro* you
Will have an Anſwer in your view.
But if the errors diſagree
That is, if th' one *Reſult* ſhall be,
Too much, *th' other* too ſmall you ſee,
The *Sum* of the two products, then
Moſt certain, is your dividend,
And *th' Sum* o'th' errors then moſt clear,
Is your diviſor—ſo take care,
For th' quote's the Anſwer I declare.

EXAMPLE I.

A merry old workman, a thraſher of corn,
Agreed with a Farmer, one *Anthony Horn*,

To

To thrash him his Wheat, at ten groats for a Score,
Two and sixpence his Barley, th' Sum was no more,
One hundred Bushels he thrash'd to his mind
And then he received the sum here subjoin'd. * } * 14*s* 2*d*
How much of each sort, then be pleased to find
Did he thrash, e're he call'd for a full flowing bowl,
For like *Stephen Duck*, he's a tippling soul.

Suppose 60 to } be the No. of Bush. of { Wh. } the thrash-ing of which, at { 3*s* 4*d* } *per* Score amts. to { 120*d*
Then (*per* Q.) 40 wou'd } be the No. of Bush. of { Bar. } the thrash-ing of which, at { 2*s* 6*d* } *per* Score amts. to { 60*d*

The Sum of which is 180
which shou'd be only 14*s* 2*d* = 170
First Error 10

Again, Suppose 56 to } be the No. of Bush. of { Wh. } the thrash-ing of which, at { 3*s* 4*d* } *per* Score amts. to { 112*d*
Then (*per* Q.) 44 wou'd } be the No. of Bush. of { Bar. } the thrash-ing of which, at { 2*s* 6*d* } *per* Score amts. to { 66*d*

The Sum of which is 178
which shou'd be only 14*s* 2*d* = 170
Second Error 8

60 56
10 8 (40

Whence according to the *Rule*
From 56 } × { 10 } = { 560
Take 60 } × { 8 } = { 480

and the *diff.* of the Prod. is 80 which divide by 2 the

Oo *dif-*

difference of the Errors, and the Quotient will be 40 the number of Bushels of Wheat, and consequently 60 must be the number of Bushels of Barley, as is easily prov'd

$$\left.\begin{array}{l}\text{for}\\ \text{and}\end{array}\right\}\text{the thrashing of}\left\{\begin{array}{c}40\\60\end{array}\right\}\text{Bushels of}\left\{\begin{array}{l}\text{Wheat}\\ \text{Barley}\end{array}\right\}\text{at}\left\{\begin{array}{rr}\mathit{s}&\mathit{d}\\3&4\\2&6\end{array}\right\}\text{p. Score amts. to}\left\{\begin{array}{rr}\mathit{s}&\mathit{d}\\6&8\\7&6\end{array}\right\}$$

The qty. thrash'd *viz* 100 Bush. wch. *p.* Q. amts. to 14 2

Solution when *both the Errors* are in *defect viz.* when the *Result* of both Suppositions are *too little.*

$$\left.\begin{array}{l}\text{Suppose 26 to}\\ \text{Then (\textit{per} Q.) 74 wou'd}\end{array}\right\}\text{be the No. of Bushels of}\left\{\begin{array}{l}\text{Wheat}\\ \text{Barley}\end{array}\right.$$

with which proceed according to the conditions of the Question (the same as in the preceding *page*) and the Result will be found to be only 163, which is *too little* by 7 the first Error.

$$\left.\begin{array}{l}\text{Again, Suppose 20 to}\\ \text{Then (\textit{per} Qu.) 80 wou'd}\end{array}\right\}\text{be the No. of Bushels of}\left\{\begin{array}{l}\text{Wheat}\\ \text{Barley}\end{array}\right.$$

with which proceed according to the Conditions of the Question and the Result will be found to be only 160 which is *too little* by 10 the second Error. Then agreeable to the *Rule*, the Errors being of the *same kind*,

$$\left.\begin{array}{l}\text{From 26}\\ \text{Take 20}\end{array}\right\}\text{the}\left\{\begin{array}{l}\text{1st}\\ \text{2d}\end{array}\right\}\text{Supposition multiplied by}\left\{\begin{array}{r}10\\7\end{array}\right\}\text{the}\left\{\begin{array}{l}\text{2d}\\ \text{1st}\end{array}\right\}\text{Error}=\left\{\begin{array}{r}260\\140\end{array}\right.$$

and the *Difference* of the Products will be 120 which divide by 3 the *Difference* of the Errors, and the Quotient will be 40 the Number of Bushels of Wheat the same as in the preceding *page.*

Solution

Solution with an *Error* of *Defect* and *Excess viz.* when the *Result* of one Supposition is *too little* and the other *too great.*

$$\left.\begin{array}{r}\text{Suppose 34 to}\\ \text{Then (\textit{per} Qu.) 66 wou'd}\end{array}\right\}\text{be the No. of Bushels of}\left\{\begin{array}{l}\text{Wheat}\\ \text{Barley}\end{array}\right.$$

The Result whereof according to the Conditions of the Question will only be 167, which ought to have been 170 and therefore is *too little* by 3 the first Error.

$$\left.\begin{array}{r}\text{Again, Suppose 80 to}\\ \text{Then (\textit{per} Qu.) 20 wou'd}\end{array}\right\}\text{be the No. of Bushels of}\left\{\begin{array}{l}\text{Wheat}\\ \text{Barley}\end{array}\right.$$

The Result whereof according to the Conditions of the Question will be found to be 190, but shou'd only be 170, and therefore is *too much* by 20 the second Error. Then agreeable to the *Rule*, as the Errors are of a *different kind,*

$$\left.\begin{array}{r}\text{To 34}\\ \text{Add 80}\end{array}\right\}\text{the}\left\{\begin{array}{l}\text{1st}\\ \text{2d}\end{array}\right\}\text{Supposition multiplied by}\left\{\begin{array}{l}20\\ 3\end{array}\right\}\text{the}\left\{\begin{array}{l}\text{2d}\\ \text{1st}\end{array}\right\}\text{Error}=\left\{\begin{array}{l}680\\ \underline{240}\end{array}\right.$$

and the *Sum* of the Products will be 920 which divide by 23 the *Sum* of the Errors, and the Quotient will be 40 the number of Bushels of Wheat, the same as before. And thus you see let the Errors happen *how they will*, the Answer may be easily obtained by paying a due regard to the *Rule* in *page* 432, and from whence is deduced this

COROLLARY

$$\left.\begin{array}{r}\text{As}\\ \text{\textit{Or} As}\end{array}\right\}\text{the}\left\{\begin{array}{l}\textit{Diff.}\\ \textit{Sum}\end{array}\right\}\text{of the Errors if they are of}\left\{\begin{array}{l}\text{the \textit{same}}\\ \text{a \textit{different}}\end{array}\right\}\textit{kind}$$

is to the Difference of the Suppositions, so is the least Error to the Correction of the Supposition belonging

to this Error, which muſt be added to or ſubtracted from ſuch Suppoſition according to the following Conditions *viz.*

If the Errors be of the *ſame kind* and the Suppoſition belonging to the leaſt Error

be $\left\{\begin{matrix}\textit{gr.}\\ \\ \textit{leſs}\end{matrix}\right\}$ than the other Suppoſition $\left\{\begin{matrix}\textit{add}\\ \\ \textit{ſub.}\end{matrix}\right\}$ the Correction $\left\{\begin{matrix}\text{to}\\ \\ \text{fr.}\end{matrix}\right\}$ its Suppoſition, and the $\left\{\begin{matrix}\textit{Sum}\\ \\ \textit{Diff.}\end{matrix}\right\}$ will be the Anſwer.

But if the Errors be of a *different kind* and the Suppoſition belonging to the leaſt Error

be $\left\{\begin{matrix}\textit{gr.}\\ \\ \textit{leſs}\end{matrix}\right\}$ than the other Suppoſition $\left\{\begin{matrix}\textit{ſub.}\\ \\ \textit{add}\end{matrix}\right\}$ the Correction $\left\{\begin{matrix}\text{fr.}\\ \\ \text{to}\end{matrix}\right\}$ its Suppoſition, and the $\left\{\begin{matrix}\textit{Diff.}\\ \\ \textit{Sum}\end{matrix}\right\}$ will be the Anſwer.

In the *firſt Solution* of the preceding Queſtion in *page* 433,

the $\left\{\begin{matrix}\text{1ſt}\\ \\ \text{2d}\end{matrix}\right\}$ Suppoſition is $\left\{\begin{matrix}60\\ \\ 56\end{matrix}\right\}$ and its Error $\left\{\begin{matrix}10\\ \\ 8\end{matrix}\right\}$ in Exceſs.

Now the Errors being of the *ſame kind* or *affection* therefore (according to the beforementioned *Corollary*) the *Analogy* will be As 2 the *Difference* of the Errors (becauſe they are of the *ſame kind*) is to 4 the Difference of the Suppoſitions, ſo is 8 the *leaſt Error*, to 16 the Correction of the Suppoſition belonging to this Error, which *ſubtract* from its Suppoſition 56 (becauſe the Errors are of the *ſame kind*, and the Suppoſition belonging to the leaſt Error is *leſs* than the other Suppoſition, ſee the *Corollary*) and the *Remainder* will be 40 the Number of Buſhels of Wheat the ſame as in the preceding *page*.—The Proof of the other two *Solutions* by the abovementioned *Corollary* is ſo eaſy that it is needleſs to inſert it.

EXAM-

EXAMPLE 2.

Three perſons *A*, *B* and *C* ſpent a certain Sum at an Alehouſe, and at paying the Reckoning, *A* threw down *a Crown* and *one fifth* of the whole, *B* threw down *one fourth* of the whole, and *C* paid the reſt, being *three tenths* of the whole. What was the Reckoning, and what did each pay?

Suppoſe the Sum ſpent was 8*s*, then (*per* Queſtion) $5+1.6+2+2.4=11$ which ought to have been but 8 therefore $11-8=3$ is the firſt Error.

Again, Suppoſe the Sum ſpent was 15*s*, then (*per* Queſtion) $5+3+3.75+4.5=16.25$ which ought to have been but 15, therefore $16.25-15=1.25$ is the other Error.

Now as the Errors are of the *ſame kind*, therefore according to the *Rule* in *page* 432.

$$\begin{array}{l} \text{From } 15 \\ \text{Take } \ \ 8 \end{array}\Bigg\} \times \Bigg\{ \begin{array}{l} 3 \\ 1.25 \end{array} \Bigg\} = \Bigg\{ \begin{array}{l} 45 \\ 10 \\ \hline \end{array} \qquad \begin{array}{ccc} 8 & & 15 \\ & \times & \\ 3 & & 1.25 \end{array} \ (20$$

and the *Diff.* of the Prod. will be 35 which divide by 1.75 the *Difference* of the Errors, and the Quotient will be 20 the Number of Shillings ſpent, whereof *A* paid a Crown and $\frac{1}{5}=9s$, *B* paid $\frac{1}{4}=5s$ and *C* paid the reſt *viz.* $\frac{3}{10}=6s$, which ſeveral ſhares added together make 20*s* the whole Reckoning, the ſame as above.

Note. The above Queſtion I propos'd in *Palladium* 1767, and which was anſwer'd nearly in the above manner by Maſter *John Flint*, an ingenious pupil of Mr. *Nathaniel Brownell's* of *Coventry*, under whoſe *Solution* is a general Rule (the ſame in ſubſtance or

meaning, as that which I have given in verse in *page* 432) and the following lines.

> " Errors *unlike*, Addition use,
> " But when *alike*, Subtraction choose."

Solution of the Question by the *Corollary* in *page* 435.

As 1.75 the *Difference* of the Errors (because they are of the *same kind*) is to 7 the Difference of the Suppositions, so is 1.25 the least Error, to 5 the Correction of the Supposition belonging to this Error, and now as the Errors are of the *same kind*, and the Supposition belonging to the least Error is *greater* than the other Supposition, therefore (pursuant to the directions of the abovementioned *Corollary*) *add*, the Correction 5, to its Supposition 15, and the *Sum* will be 20 the Number of Shillings spent, the same as in the preceding *page*.

But this Question may be very easily solved (and indeed so may many curious things) by *Vulgar Fractions* only, for the Shares or Fractions in this Question *viz.* $\frac{1}{5}$, $\frac{1}{4}$ and $\frac{3}{10}$ (reduced to a Common Denominator by the *Note* to *Case* 9 *page* 251 and) added together make $\frac{15}{20}=\frac{3}{4}$ which being all the Reckoning except the 5*s* that *A* paid over and above the $\frac{1}{5}$, it is therefore very plain that 5*s* must be $\frac{1}{4}$ of the Reckoning and consequently $5\times4=20$ Shillings the whole of it, the same as before.

EXAMPLE 3.

Inscrib'd to the Ladies.

Hail, lovely *Nymphs!* while I this tale impart,
Cupid, a *Swain* hath wounded to the heart,
'Tis an inconstant *Fair*, his suit denies,
His humble suit, nay all his art defies.

His

His name fair *Ladies* if you chuse to know,
It may be found from what appears below, *
Which being known, pity the slighted *Swain*,
Who's fetter'd strong in love's tormenting chain.

Suppose the first letter's place to be 2, then (*per* Qu.) $2+2\times3+2+2=12$ but ought to be 22, therefore $22-12=10$ is the first Error and is in *Defect*.

Again, Suppose the first Letter's place to be 6, then (*per* Qu.) $6+6\times3+2+6=32$, which ought to have been but 22, therefore $32-22=10$ is the second Error but is in *Excess*. Now as the Errors are of *different kinds* or *affections*, therefore according to the *Rule* in *page* 432,

$$\begin{array}{ccc} 2 & & 6 \\ & \times & \\ 10 & & 10 \end{array} \quad (4$$

To $2\times10=20$

Add $6\times10=60$

and the *Sum* of } —
the Prods. will be } 80 which divide by 20 the *Sum* of the Errors, and the Quotient will be 4 the first Letter's place.——But here it may be observed, that when the Errors happen to be *ulike* in *Quantity* but *unlike* in *Quality* (as in this *Solution*) the Answer may be more easily obtained than by proceeding as above, for in such Case, half the Sum of the Suppositions will be the Number sought as in this *Solution*; the Sum of the Suppositions 2 and 6 is 8, half whereof is 4 the first Letter's place, the same as above.

---

* This person's Name consists of three Letters, the first and third are the same, the second Letter's place in the Alphabet is 3 times *that* of the first or third more 2, and the Sum of the places of all the 3 Letters is 22.

And

And here I wou'd just observe that it is *oftentimes* (if not always) of great advantage (by saving a deal of work in most Solutions) to make a *Cypher* and an *Unit* the two Suppositions, as in the preceding Question, Suppose the first Letter's place to be 0, then (*per* Qu.) $0+\overline{0\times3+2}+0=2$ which ought to have been 22, therefore $22-2=20$ is the first Error, and is in *Defect*.

Again, Suppose the first Letter's place to be 1, then (*per* Qu.) $1+\overline{1\times3+2}+1=7$ which ought to have been 22, therefore $22-7=15$ is the other Error, and is also in *Defect*. Now the Errors being of the *same kind* therefore according to the *Rule* in *page* 432,

$$\begin{array}{lcc} & 0 & 1 \\ \text{From } 1\times20=20 & \times & (4 \\ \text{Take } 0\times15=\ \ 0 & & \\ \quad\quad\quad\quad\quad\quad\ \ - & 20 & 15 \end{array}$$

and the *Diff.* of the Prod. will still be 20 which divide by 5 the *Difference* of the Errors, and the Quotient will be 4 the first Letter's place, the same as above.

$$\left.\begin{array}{l}\text{Now the first Letter's place being } 4 \\ \text{the 2d (by the Qu.) must be } \overline{4\times3+2}=14 \\ \text{and the 3d, or last, the same as the 1st \textit{viz.} } 4\end{array}\right\}=\left\{\begin{array}{l}D\\O\\D\end{array}\right.$$

whence *D O D* is the person's Name.

To the inconstant Celia.

When pretty Maids inconstant prove,
The youthful Swains must die for love,
O! gentle *Fair!* to *D O D* be kind,
And ease his wild distracted mind.

Example 4.

Old *Simon*'s dead, and *Margery* is found
A buckfome Widow with a *thousand Pounds*,

'Cause

'Cause she hath *Gold*, many a courting go,
Both *Old* and *Young*, the *Clown* and *fribbling Beau*,
She treats them kindly, *Ladies* you must know.
Her Age and Number of Sweethearts you'll find,
From what you see is underneath subjoin'd. *

Suppose $\underline{0}$ for the Number of Sweethearts, then (*per* Qu.) $\overline{0\times6}+10=10$, one fourth of which is 2.5 which add to 0 and the Sum will still be 2.5 which ought to have been 65, therefore $65-2.5=62.5$ is the first Error, and in *Defect*.

Again, Suppose the Number of Sweethearts to be 1 then (*per* Qu.) $\overline{1\times6}+10=16$, one fourth whereof is 4 which add to 1 and the Sum will be 5 which should have beeen 65, therefore $65-5=60$ is the other Error, and in *Defect* also. Now the Errors being both of the *same kind*, therefore according to the *Rule* in *page* 432,

	0		1	
From $1\times62.5=62.5$		X		(25
Take $0\times60\ =0$				
	62.5		60	

and the *Diff.* of the Prods. will still be 62.5 which divide by 2.5 the *Difference* of the Errors, and the Quotient will be 25 the Number of Sweethearts.

Or according to the *Corollary* in *page* 435. As 2.5 the *Difference* of the Errors (because they are of the *same kind*) is to 1 the Difference of the Suppositions, so is 60 the least Error, to 24 the Correction of the

* Six times the Number of Sweethearts *more* ten is just four times the Widow's Age, and the Sum of both is 65.

Supposition

Supposition belonging to this Error, which Supposition being *greater* than the other, and the Errors of the *same kind*, therefore (pursuant to the beforementioned *Corollary*) *add* 24 the Correction, to its Supposition 1, and the *Sum* will be 25 the Number of Sweethearts, as before, and consequently

$$\frac{\overline{25}\times6+10}{4}=40 \text{ must be the Widow's Age.}$$

In Answer to this Question the undermentioned *Gentlemen* have written in the *Ladies Diary* for 1765 as under.

Mr. *Malachy Hitchens.*

Margery's Age is forty Years,
Her Sweethearts five and twenty;
How plainly *Avarice* appears,
In bringing her such plenty:
Had she *ten thousand Charms* in store,
But wanted *One, in Money*,
I dare affirm, of all the score,
Scarce *One* wou'd be so funny.

Mr. *Isaac Tarrat* of *Epsom.*

A bucksome Widow sure! of wond'rous Parts,
Thus to attract, or wound so many Hearts;
Widow! set up a School, instruct old Maids,
If this thou canst, 'twill be the best of Trades.

Example 5.

At *Marbury* lately a Wedding has been,
One similar to it, yet never was seen,
At Church when the Bridegroom & Bride did appear,
Crowds burst out with laughter–that rumour led there.

To

To see this fine couple excited them much,
The Bridegroom deform'd,–with club feet & a crutch!
Came hopping along, and his Bride in full view
A bucksome young Lass, of a delicate hue!
While linking,–the Parson his Clark then did call,
To hold up the Bridegroom, for fear he shou'd fall.
The rites being over,—he halted away,
The bells they did ring, and the village was gay,
The Name of the Bridegroom may quickly be told,
If what you see under * vouchsafe to unfold.

☛ The Name is composed of 5 Letters, as under.

$$\text{the}\left\{\begin{array}{l}\text{2d}\\ \text{4th}\\ \text{3d}\\ \text{5th}\end{array}\right\}\text{Letters' place in the Alphabet is}\left\{\begin{array}{l}\left.\begin{array}{l}\frac{1}{4}\\ \frac{1}{7}\end{array}\right\}\text{of the 1st Letters'}\left\{\begin{array}{l}\text{place } \textit{less } 1\\ \text{place}\end{array}\right.\\ \left.\begin{array}{l}\text{the}\\ \text{the}\end{array}\right\}\text{Sum of the}\left\{\begin{array}{l}\text{4th}\\ \text{2d}\end{array}\right\}\text{and}\left\{\begin{array}{l}\text{5th}\\ \text{4th}\end{array}\right\}\text{Letters' places}\end{array}\right.$$

and the Sum of all the 5 Letters places is 48.

Suppose the first Letter's place to be 7 then (*per* Q.) $7 + 1.5 + 3.5 + 1 + 2.5 = 15.5$ but ought to be 48, therefore $48 - 15.5 = 32.5$ the first Error, and is in *Defect*.

Again, Suppose the first Letter's place to be 14 then (*per* Qu.) $14 + 3.25 + 7.25 + 2 + 5.25 = 31.75$ but ought to be 48, therefore $48 - 31.75 = 16.25$ is the other Error, and is also in *Defect*. Whence according to the *Rule* in *page* 432,

$$\begin{array}{ccc} 7 & & 14 \\ & \times & \\ 32.5 & & 16.25 \end{array} \quad (21$$

$$\left.\begin{array}{l}\text{From } 14\\ \text{Take } 7\end{array}\right\}\times\left\{\begin{array}{l}32.5\\ 16.25\end{array}\right\}=\left\{\begin{array}{l}455\\ 113.75\end{array}\right.$$

and the *Difference* of the Products will be } 341.25 which divide by 16.25, the *Difference* of the Errors, and the Quotient will be 21 the place of the first Letter.

Now

$$\text{Now as the 1st Letters' place is } 21 \quad W$$

$$\text{the}\left\{\begin{array}{l} \text{2d} \\ \text{3d} \\ \text{4th} \\ \text{and the 5th} \end{array}\right\} \begin{array}{c}\text{Letter's place}\\ \text{must be}\end{array} \left\{\begin{array}{c} \frac{1}{4}\text{ of } 21-1 \\ 8+3 \\ \frac{1}{7}\text{ of } 21 \\ 5+3 \end{array}\right\} = \left\{\begin{array}{c} 5 \\ 11 \\ 3 \\ 8 \end{array}\right\} \textit{viz.} \left\{\begin{array}{c} E \\ L \\ C \\ H \end{array}\right.$$

The Sum of all the Letters places is 48 which shew the Bridegroom's Name to be *W E L C H.*

And here I would observe to the Learner, that the *Rule of Position* will not bring out true Answers when the Numbers sought ascend above the first Power, for in that case (as Mr. *Hutton* justly remarks in his Arithmetic, *page* 140) the Results are not proportional with their Positions, nor the Errors with the difference of the true Number and each Position, yet in all such cases (as that *Gentleman* adds) it is a very good Approximation, and in exponential Equations, as well as many other things, succeeds better than perhaps any other method. And as the *Rule of Position* is so very useful in solving many intricate Problems, not only in *Arithmetic*, but also in *Algebra* and most parts of the *Mathematics*, therefore in order to obviate any difficulty that can possibly occur in this excellent *Rule of Position*, I shall give a Question or two wherein the Method of Approximation will be shewn, and also that sometimes Questions of that kind, *viz.* such as cannot be solved by the *general Rule* in *Double Position*, may be transformed into others, resolvable thereby, or by some of the more easy *Rules* of *Arithmetic*.

EXAM-

Example 6.

How old muſt a perſon be that if 22 be added to his Age, the Square Root of the Sum may be 8?

Suppoſe the Age to be 14 then (*per* Q.) 14+22=36, the Square Root whereof is 6, which ſhou'd have been 8, therefore 8—6=2 is the firſt Error and is in *Defect*.

Again, Suppoſe the Age to be 59 then (*per* Qu.) 59+22=81, the Square Root whereof is 9, which ſhou'd have been but 8, therefore 9—8=1 is the other Error but is in *Exceſs*. Now as the Errors are of *different kinds* therefore agreeable to the *Rule* in *page* 432.

14 X 59 (44

2 1

To 14×1= 14

Add 59×2=118

and the *Sum* of the Prods. will be 132 which divide by 3 the *Sum* of the Errors, and the Quotient will be 44, which will not (for the Reaſon given in *page* 444) anſwer the Conditions of the Queſtion, for upon trial (according thereto) will be found to have an Error of .12 in *Exceſs*. Now in order to approach nearer to the Anſwer, proceed with this Error and the Number that produc'd it, along with either of the preceding Suppoſitions ſuppoſe the firſt and its Error, according to the *Rule* in *page* 432, *viz.* as the Errors are of a *different kind*, therefore

44 X 14 (42.3

.12 2

$$\left.\begin{matrix}\text{To } 44\\ \text{Add } 14\end{matrix}\right\}\times\left\{\begin{matrix}2\\ .12\end{matrix}\right\}=\left\{\begin{matrix}88\\ 1.68\end{matrix}\right.$$

and the *Sum* of the Products will be 89.68 which divide by 2.12 the *Sum* of the Errors, and the Quotient will be 42.3

 which

which also will not (for the Reason given in *page* 444) answer the Conditions of the Question, but will be *very near* doing so, for upon trial it will be found to produce so small an Error as .0187 which being so small in *Excess* makes it plain that the Number 42.3 is but a little too much, and therefore without proceeding any further, there is great reason to believe that 42 is the Number sought, but in order to become more certain thereof without trying it by the Question, and to shew the learner that the further we proceed the nearer we shall get to the Answer, let us proceed with the Error .0187 and the Number that produc'd it, along with the preceding Number found *viz.* 44 and its Error, according to the *Rule* in *page* 432 *viz.* the Errors being of the *same kind*, therefore

42.3   44

From $42.3 \times .12 = 5.076$ X   (42 nearly

Take $44 \times .0187 = .8228$

and the *Diff.* of the Prods. will be } ——— .0187   .12

4.2532 which divide by .1013 the *Difference* of the Errors, and the Quotient will be *nearly* 42 and which will answer the Conditions of the Question, consequently 42 is the Age required.

But here it may not be amiss to observe that in these kind of Questions where the Number sought ascends above the first Power it is best to use those Suppositions that are the *least erroneous*, for if instead of the Supposition 14 in the second Operation, the Supposition 59 had been used it having the least Error of those two Suppositions, consequently it is nearer the Number sought, and therefore by working with it (along with the Supposition 44) the Answer will be sooner approximated than as above, as appears by the following Operation.

From

$$\left.\begin{array}{l}\text{From } 44\\ \text{Take } 59\end{array}\right\} \times \left\{\begin{array}{c}1\\ .12\end{array}\right\} = \left\{\begin{array}{l}44\\ 7.08\\ \overline{36.92}\end{array}\right. \quad \begin{array}{ccc}44 & & 59\\ & \mathbf{X} & \\ .12 & & 1\end{array} \quad (42 \text{ nearly}$$

and the *Diff.* of the Prods. will be 36.92 which divide by .88 the *Difference* of the Errors, and the Quotient will be *nearly* 42 the Anſwer, the ſame as before.

But this Queſtion may be far more eaſily ſolv'd than by the preceding method of Approximation, for it is plain before the Square Root is extracted (ſee the Queſtion *page* 445) the Sum muſt be equal to the Square of 8 *viz.* 64. Whence the Queſtion is eaſily transformed to this *viz.* What Number is that, to which if 22 be added the Sum may be 64?–The Anſwer to this Queſtion and conſequently to that in *page* 445 (the Anſwer to the one being the Anſwer to the other) will by the *Rule* in *page* 432, or by the *Corollary* in *page* 435, be eaſily found to be 42 the ſame as above.

But the Queſtion being transform'd as above is become ſo ſimple and eaſy, that it may be ſolv'd by *Subtraction* only, for from 64 take 22 and the Remainder will be 42 the Anſwer, the ſame as before.

Example 7.

What Number is that which multiplied by $\frac{1}{9}$ of itſelf, the Product may be 81?

It is plain from what is ſaid in *page* 444 and from the nature of the Queſtion that an *exact* Anſwer thereto cannot be obtained by the *Rule of Poſition*, but that (after the manner of the preceding Queſtion) it may be approximated to any deſired degree of exactneſs, but the Anſwer may be more eaſily found out by

by transforming the Question, for it is manifest that $\frac{1}{9}$ of the Square of the Number sought must be 81, therefore the Number sought must be the Square Root of the Answer to the following Question *viz.* What Number is that which being divided by 9 the Quotient may be 81? the Answer thereto will by *Single Position* be easily found to be 729; or by *Multiplication* only, for $81 \times 9 = 729$ which is the Square of the Number sought, and consequently the Square Root of 729 *viz.* 27 must be the Number sought or required.

EXAMPLE 8.

Young *Hodge* a homely Country Swain,
Long courted *Susan* of the Plain,
But never cou'd a method find,
To bring the Fair-One to be kind.
Her pride is center'd in herself,
She calls him Clown and Country Elf,
And mimicks fashion with an air,
For dressing few with her compare.
This Charmer's Name with ease you'll find,
From what is underneath subjoin'd, *
O! tell the way to make her kind.

* This Maiden's Name is composed of 3 Letters, as under.

$$\text{the} \left\{ \begin{array}{c} \text{2d} \\ \\ \text{3d} \end{array} \right\} \text{Letter's place in the Alphabet is the} \left\{ \begin{array}{l} \text{Sum of the Squares of the 1st and 3d Letters' Places } \textit{more} \\ \text{1st Letter's Place } \textit{less} \end{array} \right\} 1$$

and the Sum of all the 3 Letters' Places is 19.

$$\begin{array}{l} \text{Suppose 4 to} \\ \text{Then (}\textit{per}\text{ Q.) } 4^2 + \overline{4-1}^2 + 1 = 26 \\ \text{and } 4 - 1 = \underline{3} \end{array} \left| \text{wou'd} \right\} \text{be the} \left\{ \begin{array}{c} \text{1st} \\ \text{2d} \\ \text{3d} \end{array} \right\} \text{Letter's Place.}$$

The Sum whereof is 33 which shou'd have been but 19, therefore $33 - 19 = 14$ is the first Error, and in *Excess*. Again,

Again, Suppose 6 to } be the { 1st } Letters Place.

Then (*per* Q.) $6^2+\overline{6-1}|^2+1=62$ } would { 2d
and $6-1=5$ } be the { 3d

The Sum whereof is 73 which shou'd have been only 19, therefore $73-19=54$ is the other Error, and is also in *Excess*. Now as the Errors are of the *same kind*, therefore according to the *Rule* in *page* 432,

From 4	×	54	=	216	
Take 6		14		84	

$$\begin{array}{ccc} 4 & & 6 \\ & \times & \\ 14 & & 54 \end{array} \quad (3.3$$

and the *Diff.* of the Prods. will be } 132 which divide by 40 the *Difference* of the Errors, and the Quotient will be 3.3

Now as the Places of the Letters in the Alphabet cannot but be whole Numbers, therefore the abovementioned Quotient 3.3 ought to have been a whole number only, wherefore it seems very likely that the first Letter's place of the name sought, must be either 3 or 4, and upon trial 3 will be found to Answer the conditions of the Question, for the first Letter's place being 3, the second Letter's place (by the Question) will be $3^2+\overline{3-1}|^2+1=14$ and the third Letter's place will be $3-1=2$, the sum of which three places is 19 agreeing with the Question. And now

the 1st	Letter's place being found to be	3	therefore that Letter must be	*C*
2d		14		*O*
and the 3d		2		*B*

Whence *SUSAN COB* is the Maiden's Name.

Note. This Question I propos'd in the *Ladies Diary* for 1771 with *Algebraical Equations*, which was an-

swered by Mr. *Henry Clark*, under whose Solution Mr. *Thomas Adcock* writes in advice to *Roger*, thus,

Friend *Hodge* forbear to sigh or sob
For such a one as *SUSAN COB*,
Address some other charming she,
That is more complaisant and free.
This method take; perhaps you'll find
The *haughty Fair* will grow more kind.

SCHOLIUM.

The greatest part of these Questions or Examples in *Single* and *Double Position* I published with *high Algebraical Equations* or *Fluxionary Expressions*, in the *Magazines* and *annual Publications*, (but in order to confine 'em to these *Rules of Position*, I have been obliged to make some alterations therein) and as they are most of 'em in verse, I hope they will be thought an agreeable amusement, as well as a proper exercise for my ingenious readers of both sexes, and had not this Treatise been run to such a great length, I wou'd have given a great many more of these delightful Questions, but must omit 'em in order to make room for the following Promiscuous Questions, and to shew the method of finding the *least Common Multiple* of any proposed Numbers (a thing so very curious as well as useful) and also for *a copious Collection of new Questions* to exercise all the Rules in this Treatise, and for a few *Arithmetical Paradoxes* for the amusement and exercise of youth.

PROMISCUOUS QUESTIONS.

Question 1. by Miss *Ann Nicholls*.

Ladies Diary 1761.

Old *John* who had in credit liv'd,
Tho' now *reduc'd*, a *Sum* receiv'd:
This lucky *Hit*'s no sooner found,
Than clam'rous *Duns* come swarming round:

To

To th' *Landlord*,—*Baker*,—many more,
John paid in all, Pounds ninety-four.
Half what remain'd—a friend he lent—
On *Joan* and *Self*, one fifth he spent;
And when of all these Sums bereft,
One tenth o'th *Sum receiv'd* had left,
—Now shew your skill ye learned Fair,
And to the world that *Sum* declare.

Suppose the Sum receiv'd £98 then (*per* Question) $94+2+.8=96.8$, and $98-96.8=1.2$ which according to the Supposition ought to have been $\frac{1}{10}$ of 98 *viz.* 9.8 therefore $9.8-1.2=8.6$ is the first Error, and is in *Defect.*

Again, Suppose the Sum receiv'd was £150 then (*per* Qu.) $94+28+11.2=133.2$. and $150-133.2=16.8$ which according to the Supposition ought to have been but $\frac{1}{10}$ of 150 *viz.* 15, therefore $16.8-15=1.8$ is the other Error, but is in *Excess.* Now the Errors being of *different kinds* or *affections*, therefore according to the *Rule* in *page* 432,

$$\begin{array}{ccc} 98 & & 150 \\ & \times & \\ 8.6 & & 1.8 \end{array} \quad (141$$

$$\left.\begin{matrix}\text{To } 98\\ \text{Add } 150\end{matrix}\right\}\times\left\{\begin{matrix}1.8\\ 8.6\end{matrix}\right\}=\left\{\begin{matrix}176.4\\ 1290\end{matrix}\right.$$

and the Sum of the Prods. will be 1466.4 which divide by 10.4 the *Sum* of the Errors, and the Quotient will be £141 the Answer.

Or, according to the *Corollary* in *page* 435, As 10.4 the *Sum* of the Errors (because they are of a *different kind*) is to 52 the Difference of the Suppositions, so is 1.8 the least Error, to 9 the Correction of the Supposition 150, which *subtract* therefrom (because the Errors

Errors are of a *different kind*, and the Supposition belonging to the least Error is *greater* than the other Supposition, see the beforementioned *Corollary*) and the *Remainder* will be £141 the Answer, the same as before.

Question 2. by Miss *Padmore*.

From *Palladium* for 1762.

How *Bride* and *Bridegroom's* Ages disagree,
The following *Case* resolv'd will let you see.
Nine times the *Husband's* Age, as late appear'd,
Was equal to the *Lady's* Age when squar'd.
Take twice *her* Age from *his*, and you will find,
That just sixteen will then remain behind.

Suppose 81 to } be the { *Husband's* } Age.
Then (*per* Qu.) $\sqrt{81 \times 9} = 27$ wou'd } be the { *Wife's* } Age.

and $\overline{81 - 27} \times 2 = 27$ which (by the Question) shou'd have been only 16, therefore $27 - 16 = 11$ is the first Error, and is in *Excess*.

Again, Suppose 100 to } be the { *Husband's* } Age.
Then (*per* Q.) $\sqrt{100 \times 9} = 30$ wou'd } be the { *Wife's* } Age.

and $\overline{100 - 30} \times 2 = 40$ which (by the Quest.) shou'd have been only 16, therefore $40 - 16 = 24$ is the other Error, which is also in *Excess*. Now the Errors being of the *same kind*, therefore according to the *Rule* in *page* 432,

$$\left.\begin{array}{l}\text{From } 81\\ \text{Take } 100\end{array}\right\} \times \left\{\begin{array}{c}24\\ 11\end{array}\right\} = \left\{\begin{array}{r}1944\\ 1100\end{array}\right. \qquad \begin{array}{ccc}81 & & 100\\ & \times & \\ 11 & & 24\end{array} \quad (64.92$$

and the *Difference* of } ——
the Products will be } 844 which divide by 13, the *Difference* of the Errors, and the Quotient will be

be 64.92, which will not (for the Reason given in *page* 444) answer the Conditions of the Question, but upon trial (according thereto) will be found to have an Error of .58 in *Excess*, which being so small gives great reason to believe that 64 must be the Number sought, but in order to be more certain thereof, without trying it by the Question, let us proceed with the Error .58 and the Number that produc'd it, along with the preceding Supposition 81 and its Error, according to the *Rule* in *page* 432, *viz.* as the Errors are of the *same kind*, therefore

$$\begin{array}{ccc} 64.92 & & 81 \\ & \times & \\ .58 & & 11 \end{array} \quad (64.02$$

$$\left.\begin{array}{l}\text{From } 64.92\\ \text{Take } 81\end{array}\right\} \times \left\{\begin{array}{r}11\\ .58\end{array}\right\} = \left\{\begin{array}{r}714.12\\ 46.98\end{array}\right.$$

and the *Diff.* of the Prods. will be 667.14 which divide by 10.42 the *Difference* of the Errors, and the Quotient will be 64.02, which likewise will not (for the Reason given in *page* 444) answer the Conditions of the Question, but as the other Number found, *viz.* 64.92 produc'd so small an Error as .58, and since it is plain that the further we proceed the nearer we approach to the Answer, consequently the Number last found *viz.* 64.02 must be *very near* the Number sought, wherefore it is very likely that 64 is the *Husband*'s Age, and which upon trial will be found to be so, for 64 being accounted the *Husb*'s Age.

Then (*p.* Qu.) $\sqrt{64 \times 9} = 24$ must be accounted the *Wife*'s Age, and which two Numbers answering the Conditions of the Question prove the respective Ages as above.

Note. Under several *Algebraical Solutions* to this Question (by Mr. *Pinnington*, Mr. *Antrobus*, and Mr *Johnson*, in Palladium 1763.) Mr. *John Buddle* humourously writes thus:

> "What can old *Frosty* do with such a Wife?
> "Youth tied to Age, palls all the Joys of Life."

To find least Common Multiples, &c.

Scholium.

HAVING now treated very copiously on the *Rules of Position*, and as in those *Rules* it is often very necessary (in order to avoid Fractions) to suppose such Number or Numbers as being divided by given Divisors shall leave no Remainder, therefore, and in order to shew how to solve many curious and pleasant Questions, which are not reducible to any of the preceding *Rules*, and consequently to make this Treatise as complete as possible, I shall now shew how to find the *Least Common Multiple* of any proposed Numbers, *i. e.* to find the least Number which may be divided by any Number of given Divisors, without leaving any Remainder, and to do which observe the following

Rule.

All equal Numbers—as you'll see,—
Except one may rejected be,
Such as are al'quot parts I say
Of any o'th' others, likewise may
Rejected be—and when you find
That any proposed Number—mind—
Is an al'quot part o'th' *Product*, see
Of any o'th' Numbers, two or three,
It likewise may rejected be.—
The Common Multiple * of two
Of any o'th' given Numbers, you

* Common Multiple is the Common Product of any two or more proposed Numbers, and consequently may be measured, *i. e.* divided by any of the Numbers of which it is composed without leaving any Remainder, and the Quotient will be the Product of all the other Numbers.

Must

Must true divide by what you see,
Their greatest Common Measure'll be,
The Quote's the *least Common Multiple.*
If any Number not us'd, is
An al'quot part—besure mind this—
Of the *least Common Multiple*
Last found,—such may rejected be.
—The *least Common Multiple* find
Of that before found, *Tyro* mind—
And any o'th' given Numbers, too
Not us'd.——In the same way pursue
With each new *least Common Multiple*
'Till all the proposed Numbers be
Consider'd, and the *last* you'll find,
Will be the *Least* just to your mind.

Note. It is plain from the *Rule* that when Numbers are *prime* to each other, *viz*. When they have no other Common Measure than Unity, *i. e.* when no Number but Unity will measure both, their *Common Multiple* or *Product* is their *least Common Multiple.* —A *Prime Number* is such as can be measured only by Unity and a Number equal to itself, and consequently cannot be produced by the Multiplication of any Number of Integers.

Example I.

Quere, the least whole Numbers that can be divided by the 9 Digits severally, and leave no Remainder? *Or* which is the same thing, What is their least Common Multiple?

The given Divisors being 1, 2, 3, 4, 5, 6, 7, 8 and 9 it is plain that $1\times2\times3\times4\times5\times6\times7\times8\times9=362880$ is the Common Multiple and may be divided by the 9 Digits and leave no Remainder, but in order to obtain the *least Common Multiple* or Number that will do so, the Numbers 1, 2, 3 and 4 may (according to the *Rule*) be rejected, they being aliquot parts of some

of

of the others, and as 5, 6 and 7 are *prime* to one another, therefore $5 \times 6 \times 7 = 210$ is the *least Common Multiple* of those 3 Numbers, then multiply 210 by 8 and divide the Product or Common Multiple 1680 by 2 the greatest Common Measure of 210 and 8, and the Quotient will be 840 the *least Common Multiple* of those 2 Numbers, and lastly multiply 840 by 9 and divide 7560 the Product or Common Multiple by 3 the greatest Common Measure of 840 and 9, and the Quotient will be 2520 the *least Common Multiple* or *Number* required.

Example 2.

What is the least Common Multiple of 45, 21, 85, 7, 35 and 23?

Multiply 45 by 21 and divide their Common Multiple or Product 945 by 3 their greatest Common Measure, and the Quotient will be 315, which multiply by 85 and divide the Common Multiple or Product 26775 by 5 the greatest Common Measure of 315 and 85, and the Quotient will be 5355, and as 7 (the next proposed Number) is an aliquot part of 21 (one of the preceding ones) and also 35 (the next proposed Number) an aliquot part of 5355, therefore (according to the *Rule*) those 2 Numbers 7 and 35 may be rejected, then 5355 and the remaining proposed Number 23 being *prime* to each other, therefore $5355 \times 23 = 123165$ is the *least Common Multiple* or *Number* required.

And here it may not be improper just to mention, that there are other methods of finding the *least Common Multiple*, but as that which I have here given is so plain and easy, and this Book far above the size it was first intended to be, I shall therefore say nothing about 'em, but only just observe that oftentimes a good

good deal of trouble may be saved, if instead of dividing the Common Multiple or Product of the two Numbers by their greatest Common Measure, you divide the least of the two Numbers by such Common Measure, and multiply the other Number by the Quotient, but this being so plain and easy that it wou'd be quite needless to say any thing more about it.

Example 3.

Tom the Gardener counting some Apples into a Basket, found that when he counted them in by two at a time, three at a time, and four at a time, there remained one, but when he counted 'em in by five at a time there remained none. *Quere* the Number of Apples?

The *least Common Multiple* of the Numbers 2, 3, and 4 is easily found to be 12, to which add 1 and the Sum will be 13, which divided by three of the given Numbers, *viz.* 2, 3 and 4, will leave 1 according to the Question, but divided by 5 will leave 3, which being 2 short of 5, therefore to twice 12 add 1 and the Sum will be 25, the Number required.

Example 4.

Required the least Number which being divided by 7, 6, 5, 4, 3 and 2, shall leave 6, 5, 4, 3, 2 and 1 respectively?

The *least Common Multiple* of the given Divisors 7, 6, 5, 4, 3 and 2 will be easily found (by the *Rule*) to be 420, and which is the least Number that can be divided by the given Divisors without leaving any Remainder, therefore from 420 deduct 1 and the Remainder will be 419 the Answer.

Example 5.

Required the leaſt Number that will anſwer the following Conditions, *viz.* when divided by 8 ſhall leave 4 for a Remainder, when divided by 7 ſhall leave 3, and when divided by 6 ſhall leave 2, and ſo on leaving each time 4 for a Remainder leſs than the Diviſor, till divided by 4, nothing ſhall remain?

The *leaſt Common Multiple* of the given Diviſors 8, 7, 6, 5 and 4 will (by the *Rule*) be eaſily found to be 840, which being the leaſt Number that can be divided by thoſe Diviſors without leaving any Remainder, therefore from 840 deduct 4 and the Remainder will be 836 the Number required.

Example 6.

Quere the four leaſt Numbers that will anſwer the following conditions, *viz.* when divided ſeverally by 12 ſhall each leave 11 for a Remainder, when divided ſeverally by 11 ſhall each leave 10, and ſo on, always leaving one leſs than the Diviſor, to Unity?

The *leaſt Common Multiple* of the given Diviſors 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2 and 1 will be eaſily found (by the *Rule*) to be 27720 which multiply ſeverally by 2, 3 and 4 and the Products will be 55440, 83160 and 110880, which ſeveral Numbers, *viz.* 27720, 55440, 83160 and 110880 are the four leaſt Numbers that can be divided by the given Diviſors without leaving any Remainder, from which ſeveral Numbers deduct Unity and the Remainders will be 27719, 55439, 83159 and 110879 the four leaſt Numbers required.

And now having ſhewn how to find the *leaſt Common Multiple* of any propoſed Numbers, it may not be amiſs juſt to obſerve that it is of excellent uſe *in*

reducing

reducing Fractions to their least Common Denominator, and is the *Ground* and *Explanation* of the former part of the *Note* to *Case* 9 in *page* 251, for it is plain, that the *least Common Multiple* of the Denominators is always the *least Common Denominator* that the Fractions can be reduced to, and in order to find the new Numerators thereto, divide the several Products arising from the *least Common Denominator* being multiplied into each Numerator, by the respective Denominators, and the several Quotients will be the new Numerators required. *Or*, the *least Common Denominator* divided by each Denominator separately, and the Quotients multiplied by their respective Numerators will also produce the new Numerators required, but this being so plain and easy I shall in this place say no more in relation thereto, but proceed to the next thing proposed, namely

A COLLECTION of NEW QUESTIONS

to exercise all the Rules in this Treatise.

1. IN the *Old* and *New Testament*, tell unto me
What Number of Chapters contained there be?

Answer, 1189.

2. *John* borrow'd of his Friend some cash
In part he soon paid down
Twelve golden Guineas,—still unpaid
A Noble and a Crown.
What did he borrow tell me true
In royal *British* Coin?
This *Tyro* you may quickly do,
To make your learning shine:

	£	s	d
Answer,	13	3	8.

 3. Sup-

3. Suppose *Thomas* and *Harry* buy a Piece of Timber containing 104 solid Feet, and that *Harry* is to have 67 Feet. *Quere Thomas*'s Share?

Answer, 37 Feet.

4. Suppose a Tradesman be indebted to *A* £147 16*s* 11*d*, to *B* £400 15*s* 7*d* ½, to *C* £340 19 4*d* ¾, to *D* £64 15*s* and to *E* £500, and that towards the Payment of these Debts, he has in Cash, £145, in Shop-goods £164 18*s* 4*d*, in Houshold Furniture £210 14*s* 10*d*, in a Tenement 40 Guineas and a Mark, and in recoverable Book-Debts £100 15*s* 4*d* ½. Now if these things be delivered to his Creditors, what wou'd they then lose by him?

	£	s	d
Answer,	790	5	— ¾.

5. Suppose a Person die and leave his two Sons *A* and *B* to pay a certain Debt equally, out of their respective Fortunes, and that *A* has paid £60 11*s* 4*d* ½, toward such Debt, and *B* £40 16*s* 10*d*, and that there still remains due £20 14*s* 6*d* ½. *Quere*, What has each yet to pay (as they must pay equally) of the abovementioned Debt, and what was the Debt the Father left 'em to pay?

		£	s	d
Answer, *A*	must pay	—	10	—
B		20	4	6½

and the whole Debt was £122 2*s* 9*d*.

6. What Number taken from 12 times 64, will leave 15 times 24?

Answer, 408.

7. Miss *Nancy* said—*Mamma* I find
Your Age is thirty-two,
And I just fourteen to my mind,
This you'll allow is true:

What

What will our Ages be declare,
When I am half as old
As you *Mamma?* 'tis very fair
The Question shou'd be told.

Answer, 36 and 18.

8. Suppose a Farmer sell the following quantity of Corn, *viz.*

$$\left.\begin{array}{r}140\\60\\346\\\text{and }270\end{array}\right\}\text{Bushels of}\left\{\begin{array}{l}\text{Wheat}\\\text{Rye}\\\text{Oats}\\\text{Barley}\end{array}\right\}\text{at}\left\{\begin{array}{ll}s&d\\7&3\\4&2\\2&9\frac{1}{2}\\3&6\frac{1}{2}\end{array}\right\}\textit{per}\text{ Bush.}$$

What does the whole Quantity amount to?

Answer, £ 159 s 7 d 2.

9. What Number multiplied by 1234 will produce 64168?

Answer, 52.

10. Suppose a Sawyer having measured a certain Number of Boards found them to contain 3400 Square Feet. How many Roods (of 400 Feet to the Rood) are contained therein?

Answer, 8 ½ Roods.

11. Admit a Gentleman wou'd divide 600 Acres of Land amongst his three Sons *A*, *B* and *C*, in such manner that

$$\left.\begin{array}{r}A\\\text{and } B\end{array}\right\}\text{must have}\left\{\begin{array}{c}68\\50\end{array}\right\}\text{Acres more than}\left\{\begin{array}{c}B\\C\end{array}\right.$$

What Quantity of the (600 Acres) must each have?

$$\textit{Answer},\ \left.\begin{array}{r}A\\B\\\text{and } C\end{array}\right\}\text{must have}\left\{\begin{array}{c}262\\194\\144\end{array}\right\}\text{Acres.}$$

 12. Sup-

12. Suppose a Gentleman to have 3840 Fruit Trees, in five different Nurseries, and the greatest Nursery to exceed

$$\begin{array}{r}\text{the}\left\{\begin{array}{l}\text{2d,}\\ \text{3d,}\\ \text{4th,}\end{array}\right.\\ \text{and the 5th,}\end{array}\left.\vphantom{\begin{array}{l}1\\2\\3\\4\end{array}}\right\}\text{by}\left\{\begin{array}{r}64\\146\\280\\310\end{array}\right\}\text{Trees,}$$

Quere, the Number of Trees in each Nursery?

Answer, 928, 864, 782, 648 and 618 Trees.

13. Suppose Miss *Charlotte*'s and Miss *Fanny*'s Fortunes added together make £1000, and that if you deduct the less Sum *viz*. *Fanny*'s from the other, the remainder wou'd be £76 10*s* —*d* ½. *Quere*, the respective Fortunes?

$$\begin{array}{r}\textit{Answer, Charlotte's}\\ \text{and }\textit{Fanny's}\end{array}\left.\vphantom{\begin{array}{l}1\\2\end{array}}\right\}\text{Fortune}\left\{\begin{array}{rrl}\pounds & s & d\\ 538 & 5 & -\tfrac{1}{4}\\ 461 & 14 & 11\tfrac{3}{4}.\end{array}\right.$$

14. Suppose *Job*, *Ralph*, *George* and *Thomas* have a Prize of £6489, and agree to divide it in such manner that as oft as

$$\begin{array}{r}\textit{Job}\\ \textit{Ralph}\\ \textit{George}\\ \text{and }\textit{Thomas}\end{array}\left.\vphantom{\begin{array}{l}1\\2\\3\\4\end{array}}\right\}\text{takes}\left\{\begin{array}{l}\text{a Crown,}\\ \text{half a Crown,}\\ \text{a Shilling,}\\ \text{Sixpence,}\end{array}\right.$$

Quere, each man's Share according to the abovementioned agreement?

$$\begin{array}{r}\textit{Answer, Job's}\\ \textit{Ralph's}\\ \textit{George's}\\ \text{and }\textit{Thomas's}\end{array}\left.\vphantom{\begin{array}{l}1\\2\\3\\4\end{array}}\right\}\text{Share is}\left\{\begin{array}{rl}\pounds & s\\ 3605 & -\\ 1802 & 10\\ 721 & -\\ 360 & 10.\end{array}\right.$$

15. If 4 Hogsheads of strong Beer were to be bottled off into Quart Bottles. How many Dozen wou'd they fill? *Answer*, 68 Dozen.

16. In

16. In 340 Ducatoons at 6*s* 4*d* each. How many Florins at 3*s* 2*d* each? *Answer*, 680 Florins.

17. How many Canisters of Tea each holding 16 ℔ can be filled out of 11C. 1qr. 20 ℔?

Answer, 80 Canisters.

18. If 3C. 1qr. 24 ℔ of Currants cost £6 17*s* 5*d*. How were they sold *per* ℔ when the Profit arising thereby came to £1 4*s* 3*d*? *Answer*, 5*d*.

19. Suppose I bought two hundred Eggs,
One half at five a penny,
The other half but four * I had,
I cou'd not get so many.
T' oblige a Neighbour after, I
Dispose of all this Ware,
And nothing for my Profit get,
How were they sold † declare?

* apenny.

† *i. e.* how many Eggs a penny.

Answer, $4\frac{4}{9}$ *viz.* $4\frac{1}{2}$ *nearly.*

20. Suppose a Shepherd buys 200 Sheep for £85 and after sometime sells them again for £105. Now suppose they had cost him at first £105. What must they be sold for to gain after the same Rate?

Answer, £129 14*s* $1\frac{1}{4}\frac{11}{17}$*d*.

21. Sound being found by Experiment to move 1142 Feet in 1 Second of Time, *Quere*, How long after the firing of a Cannon at *Chester*, may the report be heard at *Whitchurch*, distant 20 Miles?

Answer, 1 *Minute* $32\frac{268}{571}$ *Seconds.*

22. Admit on any certain Day at 8 o'Clock in the Morning a person sets out from *Whitchurch* to *London* which is 162 Miles, and goes at the rate of $2\frac{1}{2}$ Miles *per* Hour, and that another person sets out from *London* for *Whitchurch* at 3 o'Clock in the Evening of the

the same Day, and comes down at the Rate of 3 Miles an Hour. *Quere*, How far distant between *London* and *Whitchurch* wou'd they meet?

	Miles		Mls.	Fur.	Pls.	Yds.		
Ans.	$78\frac{9}{11}$	=	78	6	21	$4\frac{1}{2}$	from	*London*
and	$83\frac{2}{11}$		83	1	18	1		*Whitch.*

23\. *A* working alone in twelve Days can compleat
The making a Vessel of Copper quite neat,
Which wou'd take sixteen Days to be made up by *B*,
He working more slowly than *A* you may see.
Now working together, what Time will they take
Before the said Vessel compleatly they'll make?

Answer, $6\frac{6}{7}$ Days.

24\. Suppose a Gentleman having an Estate of £200 *per Annum* wou'd divide the same into two Farms, so as to be in proportion to each other as 3 to 5. *Quere*, the yearly Value of each?

Answer, £75 and £125.

25\. Suppose a Garrison consisting of 8000 Soldiers be besieged and that they have Provisions to serve 'em five Months. How many Men must depart therefrom in order that the Provisions might serve the Remainder 8 months? *Answer*, 3000 Men.

26\. *Jack Queer* a scold has to his spouse,
Old *Xantippe* outvies,
She bangs him round about the house,
Makes a perpetual noise.
Dick Hog too, has a drunken wife,
Who much consumes his store,
And makes him an unhappy life,
Thinking he shall grow poor.
At landlord *Gill's*, to have a whet
Of ale or beer they say,
These two unhappy husbands met,
Upon a certain day.

Whilst

Whilst drinking their discourse began
'Bout changing of their wives,
And as they toss about the Can,
Dick wiping of his eyes.
Says *Jack* a bargain I will make,
But something more shall crave,
Than just your wife because you know
Mine's nearer to the grave,
Each age I find's as *two* to *three*,
Their sum *one hundred years*,
So boot in hand, dear *Dick* must be,
As plainly now appears.
Says *Dick* to *Jack* I'll give to you
T'bacco as many pound,
As your wife's age exceedeth mine,
So let the Can go round.
The bargain's struck—each age unfold,
And what the whole comes to
Of the tobacco at the price
You in the margin view. * $14\frac{1}{2}$ d *per* ℔

Answer, *Jack's* / *Dick's* Wife's Age 60 / 40 Years,
and the price of the 20℔ of tobacco £1 4s 2d.

27. Suppose a Regiment of Soldiers consisting of 800 men are to be new clothed and that each man's coat will take $2\frac{3}{4}$ Yards, of yard and half wide Cloth. How many Yards of shalloon of three quarters wide will line the same? *Answer*, 4400 Yards.

28. Suppose a round Ball weighing $1\frac{1}{2}$℔ be impelled by such a force as to make it fly 380 Feet in one second of time. With what velocity wou'd a Bullet of $\frac{1}{4}$℔ weight move, if impelled by the same force? *Answer*, 2280 Feet.

29 Admit a Cistern holding 140 Gallons be supplied by a pipe with water at the rate of 48 gallons an

hour. In what time (ſuppoſing the influx and efflux of the water to be always alike) wou'd the Ciſtern be fill'd if both the pipes were ſet open at once ?

Anſwer, 10 Hours.

30. If a clock having two hands turning upon the ſame center or axis, be obſerved to have the following Motion *viz.*

$$\left.\begin{array}{r}\text{the ſlower}\\ \text{and the ſwifter}\end{array}\right\}\text{Hand to move}\left\{\begin{array}{l}3\\ 2\frac{1}{2}\end{array}\right\}\text{Rounds in}\left\{\begin{array}{l}2\frac{1}{2}\\ 2\end{array}\right\}\text{Hours.}$$

Quere, the Synodical Period of the two Hands (*i. e.* the time they would take in getting together again from their ſetting out together at one and the ſame place) and how many Revolutions wou'd each Hand make in ſuch Period ?

Anſwer, Synodical Period 20 Hours, in which time the ſlower hand wou'd make 24 Revolutions and conſequently the other 25.

31 If 8 Cows or 11 Heifers wou'd eat a field of Graſs in 108 Days, In what time (after the ſame rate of eating) wou'd 4 Cows and 5 Heifers eat the ſame ?

Anſwer, 113 $\frac{1}{7}$ Days.

32. Suppoſe twelve men ſix pounds in 8 days earn,
How many men muſt be you'll ſoon diſcern
To earn juſt fifty Guineas, and no more
In twenty days—This *Tyro* pray explore.

Anſwer, 42 Men.

33. If 10 men can build a boat in 20 days when the day is 14 hours long. In how many days (after the ſame rate of working) cou'd 18 men build the ſame when the day is 11 hours long ?

Anſwer, 14 $\frac{14}{99}$ Days.

34. In

34. In 8 Casks of Tobacco each containing 8C. 1qr. and 24 ℔. Tare 3qrs. 20 ℔ *per* Cask, Trett 4 ℔ *per* 104 ℔. and Cloff 3 ℔ for every 3C. Grofs. What does the Neat Weight come to at $8\frac{1}{4}d$ *per* ℔?

Answer, £ 219 s 17 d $9 - \frac{6}{63}$.

35. If 6 Casks of Oil weigh 20C. 1qr. 2 ℔ Grofs. How many Gallons, allowing 20 ℔ *per* C. Tare, and $7\frac{1}{2}$ lb. to the Gallon?

Answer, $248\frac{13}{21}$ Gallons.

36. Suppose a May-Pole be broke in two Parts, and that the standing Part is $11\frac{1}{4}$ Feet more than $\frac{3}{4}$ and the other Part just $\frac{1}{2}$ of $\frac{5}{9}$ $\frac{3}{4}$ of the whole.

Quere, the Length of the whole Pole, and also the Length of each Part?

Ans. 54, $33\frac{3}{4}$ and $20\frac{1}{4}$ Feet, the Length of the whole Pole, standing Part, other Part.

37. Admit a Tower or Landmark be $\frac{1}{14}$ in the Ground, $\frac{1}{10}$ in the Water, and 116 Feet above the Water. *Quere*, the whole Height thereof? *Answer*, 140 Feet.

38. Admit 12 Gallons of Beer were drawn out of a Cask after it had leaked away $\frac{1}{9}$ of the whole. What did the Cask hold, when upon being guaged there remained undrawn $\frac{5}{9}$ of the whole Quantity?

Answer, 36 Gallons.

39. Once drunken *John* to th' Alehouse went,
T' be fuddl'd was his whole intent,
One fifth o'th money in his purse,
Spent at the *George* and to make worse,
He reel'd away unto the *Bear*,
Three ninths of what he'd left spent there,

At

At laſt when to his ſenſes come,
He counts his caſh to know what Sum
Was left behind—which was no more
Than ten * and eight Pence; ſo explore   * Shils.
What Sum at firſt his Purſe had in
Ere this wild frolic did begin ?

Anſwer, 20 Shillings.

40. Suppoſe a Perſon dies and leaves the whole of his Eſtate amounting to £4060 to be divided amongſt his 6 Sons in the following manner, *viz.*

the 2d	Son to have	$\frac{3}{4}$	of the	Eldeſt	Son's ſhare
the 3d		$\frac{1}{2}$		Eldeſt	
the 4th		$\frac{1}{4}$		Eldeſt	
the 5th		$\frac{3}{4}$		4th	
and the 6th		$\frac{1}{2}$		5th	

How much of the £4060 muſt each Son receive ?

Anſwer,		£	s	d
1ſt	Son's Share	1459	15	6 — $\frac{24}{89}$
2d		1094	16	7 $\frac{1}{2}$ $\frac{18}{89}$
3d		729	17	9 — $\frac{12}{89}$
4th		364	18	10 $\frac{1}{2}$ $\frac{6}{89}$
5th		273	14	1 $\frac{3}{4}$ $\frac{49}{89}$
and the 6th		136	17	— $\frac{3}{4}$ $\frac{69}{89}$

41. A *Roman Lawyer* as the ſtory goes,
A Queſtion of this kind did firſt propoſe,
That if a perſon die and leave behind
His whole Eſtate (th' Amount is here ſubjoin'd *)
And Wife with Child then 'tis his will and mind
If of a Son ſhe ſhou'd deliver'd be,
Two thirds muſt be his Share, one third for ſhe.
But if a Daughter, then the Widow's Share,
Muſt be two thirds, the Daughter's one 3d clear.

* £8000 *per Annum.*

Now

Now ſoon the Widow is, as we deſcry,
Deliver'd of a Daughter and a Boy.
T'anſwer the Father's Will, now tell to me
How th' 'ſtate with Juſtice muſt divided be?

		£	s	d	
Anſ. Son's	Share	4571	8	$6\frac{3}{4}\frac{3}{7}$	*per Ann.*
Mother's	Share	2285	14	$3\frac{1}{4}\frac{5}{7}$	*per Ann.*
and Daughter's	Share	1142	17	$1\frac{1}{2}\frac{6}{7}$	*per Ann.*

42. Old *Derby* bought a pretty Houſe,
  To live in at his Eaſe,
At the Deſire of *Joan* his Spouſe,
  Whom he always ſtrove t'pleaſe.
But Death ſoon ſnatch'd them both away,
  To the *Elyſian* Bow'r,
And *Derby* left his Houſe they ſay
  To *Hodge*, who bleſt the Hour
That Fortune had ſo ſmil'd upon
  Him, now in time of need,
Becauſe he had —— O! ſilly Man,
  Spent all he had indeed.
And thro' Extravagance we find,
  The Houſe was quickly ſold,
For juſt three fourths of what it coſt,
  O! ſhocking to be told.
His Debtors ſwarm about like Bees,
  Three of them *A*, *B*, *C*,
Now will be paid or elſe to Goal,
  They'll ſend him inſtantly.
And Landlord *Swilltub* does proteſt,
  Unleſs he'll pay his Score,
For Ale and Liquor of the beſt,
  He ſhan't have Freedom more,
But rot in Goal —— for ought he cares!
  How hard-heart'd Landlords be!
Their tempting Baits and dainty Wares
  Bring Men to Poverty.

 Hodge

Hodge being seiz'd, no more cou'd do,
But pay to Debtors three,
One third, two ninths, three fifteenths——so
He paid *A*, *B* and *C*.
One fifth to *Swilltub* likewise paid——
When of these Sums bereft,
Three Pounds six Shillings and eight Pence,
Was all that *Hodge* had left.
Still, still perplex'd with clam'rous din,
For drabbling debts was he,
Till ev'ry Farthing's paid and gone——
Now *Tyro* tell to me,
What Cash the House was sold for——too
What *Derby* paid likewise
For it——All this with Ease you'll do,
And to Mount Science rise.

Answer, the House was sold for £75 and cost £100.

Note. This Question, *viz.* the 42d, is proposed as a Caution to shun ill Company and Extravagance.

43. Now we'll suppose from th' Center of a Tow'r,
On level Ground one hundred Yards and four,
And from the bottom of this lofty Pile,
Unto the Top two eightieths of a Mile.
A Rope from th' Top quite reaches to the Ground,
Whose Length in Yards may easily be found.
A Flyer on this Rope descends in sight,
From th' Tower's Top he takes amazing Flight.
—This scaling Rope's true Length with ease you'll [find,
From *Euclid*'s Rule * that's hereunto subjoin'd.

* In every right angled Triangle

the {*Sum* / *Diff.*} of the *Squares* of the {*Base* / *Hyp.*} and {*Perp* / *Base.*} is equal to the *Square* of the {*Hypoth.* / *Perp.*}
and the *Diff.* of the *Squares* of the *Hyp.* and *Perp.* is equal to the *Square* of the *Base.*

Answer, 112.924 Yards, *viz.* 113 nearly.

44. Ad-

44. Admit the Height of a Castle Wall be $60\frac{1}{2}$ Yards, and a scaling Line drawn from the Top of the Wall to the further side of the Castle Ditch $200\frac{1}{4}$ Yards. *Quere* the Breadth of the Ditch?

Answer, 190.892 Yards.

45. Suppose the length of a scaling Ladder from the Ground to the top of an Edifice be 40 Feet, and from the foot of the Ladder to the bottom of the Edifice 30 Feet. What is the Altitude of the Edifice?

Answer, 26.457 Feet, or nearly $26\frac{1}{2}$.

46. Admit the height of a Mountain be 4 Miles above the surface of the Sea, and the Semidiameter of the Earth 3984.58 Miles. How far may the Mountain be seen at Sea, the eye of the spectator being supposed to be on the surface of the Water?

Answer, 178.585 Miles.

47. If a Pipe of a Cock whose Diameter is 2 Inches will fill a Cistern in half an Hour. What must the Diameter of another Pipe be to fill it in quarter of an Hour? *Answer*, 2.828 Inches.

48. Admit a Cubical Stone to contain 884736 solid Inches. How many Feet of Board wou'd cover the same? *Answer*, 384 Feet.

49. Suppose a Cellar be to be dug $20\frac{1}{2}$ Feet every way, *i. e.* in Length, Breadth and Depth. How many solid Feet of Earth must be digged up to complete the same? *Answer*, 8615.125 Feet $=8615\frac{1}{8}$ Feet.

50. If a Bullet whose Diameter is $3\frac{1}{4}$ Inches weigh $7\frac{1}{4}$ lb. What wou'd be the Diameter of another Bullet of the same metal weighing $40\frac{1}{2}$ lb?

Answer, 6.2102 Inches.

51. Suppose the sides of two Cubes be 5 and 7 Inches. Required the side of another Cube that shall be equal in solidity to the two given Ones.

Ans. 7.763936 *viz*. a little more than $7\frac{3}{4}$ Inches.

 52. What

52. What is the Simple Intereſt of £540 8*s* 9*d* for 8 $\frac{3}{4}$ Years at £4 $\frac{3}{8}$ *per Cent. per Annum?*

£ *s* *d*
Anſwer, 206 17 8 $\frac{1}{2}$ $\frac{25}{32}$.

53. If *A* ſhou'd mortgage his Eſtate,
For a thouſand Pounds t' *B*,
Allowing Int'reſt at the Rate
You in the Margin * ſee.
And that th' Sum remain'd to *B*'s mind,
Nine Years nine Months not more,
Before *A* cou'd a method find,
To pay him off his ſcore.
Then tell to me the whole Amount,
That *A* muſt pay to *B?*
Haſte *Tyro*, haſte, begin to count,
You'll do it inſtantly.

* £4 $\frac{3}{4}$ *per Cent. per Annum* Simple Intereſt.

£ *s* *d*
Anſwer, 1463 2 6.

54. At what Rate of Simple Int. will £432 5*s* 10*d* amount to £560 10*s* 5*d* in 6 Years and 216 Days?

Anſwer, £4 $\frac{1}{2}$ *per Cent.*

55. Admit a perſon lent 100 Guineas at £5 *per Cent. per Annum*, Simple Intereſt, and on the firſt day of *June* 1773, receiv'd £1 6*s* 3*d* for every Guinea. When muſt the Money have been lent?

Anſwer, On the firſt day of *June*, 1768.

56. Suppoſe a perſon (on one and the ſame day) puts out £200 at £4$\frac{1}{2}$ *per Cent. per Annum*, and £260 at £3 *per Cent. per Annum*. In what time at Simple Intereſt wou'd they exactly have the ſame Amount?

Anſwer, 50 Years.

57. What muſt a perſon give for £646 12*s* *South-Sea Annuities*, at £124 $\frac{1}{4}$ *per Cent?* *Anſ.* £803 8*s*.

58. What is the Compound Intereſt of £450 10*s* for 8 Years at £4 *per Cent. per Annum?*

Anſwer, £166 –*s* 9 $\frac{1}{4}$*d*.

59. What

59. What is the present Worth of £640 4*s* 3*d* due 3 Years and 234 Days hence at £4 $\frac{1}{2}$ *per Cent. per Annum*, Compound Interest? *Ans.* £545 8*s* 1 $\frac{1}{4}$*d*.

60. What will £200 amount to in 1 $\frac{3}{4}$ Year at £4 *per Cent. per Annum* Compound Interest, supposing the Interest payable quarterly? *Ans.* £214 8*s* 6$\frac{1}{4}$ +.

61. At what Rate *per Cent. per Annum* Compound Interest will £230 amount to £413 —*s* 11 $\frac{1}{4}$*d* in 12 Years? *Answer*, £5 *per Cent.*

62. What is the Discount of £260 10*s* due 4 Years hence at £4 $\frac{3}{4}$ *per Cent. per Annum* Simple Interest? *Answer*, £41 11*s* 10*d* − $\frac{88}{119}$.

63. Admit a Tradesman sell Goods to the Value of £140 10*s* 6*d* to be paid in manner following, *viz.*

$$\left.\begin{array}{r}\text{£}\\ 50\\ 30\\ \text{and the rest}\end{array}\right\}\text{ at the End of }\left\{\begin{array}{c}3\\ 5\\ 8\end{array}\right\}\text{ Months}$$

Quere the present Worth of the whole, allowing Discount at £6 $\frac{1}{2}$ *per Cent. per Annum?*

Answer, £136 8*s* 4 $\frac{3}{4}$*d* +.

64. Suppose *Thomas* owes *Richard* £200 to be paid in manner following, *viz.*

$$\left.\begin{array}{r}\text{£}\\ 80\\ 60\\ 40\\ \text{and } 20\end{array}\right\}\text{ at the End of }\left\{\begin{array}{c}2\\ 2\frac{3}{4}\\ 3\frac{1}{2}\\ 4\frac{3}{4}\end{array}\right\}\text{ Years}$$

Quere the equated Time for payment of the whole?

Answer, 2 $\frac{4}{5}$ Years.

65. Suppose a person be under an Agreement to discharge a Debt in the following manner, *viz.*

$$\left.\begin{array}{r}\frac{1}{3}\\ \frac{1}{4}\\ \text{and the Remainder}\end{array}\right\}\text{ at the End of }\left\{\begin{array}{c}10\\ 16\\ 20\end{array}\right\}\text{ Months}$$

Quere the equated time for Payment of the whole?

Answer, 15 $\frac{2}{3}$ Months.

66. Suppose a Clothier buys Goods to the value of £300 and by Agreement is to pay the same at the End of 4 Months, Now admit he pays £60 in hand in order to procure a longer time for the Payment of the remainder. In what time ought the remainder to be paid? *Answer*, 5 Months.

67. Suppose four persons *A*, *B*, *C* and *D* purchase an Estate and agree that *A* shall pay $\frac{2}{5}$ of the Purchase Money, *B* $\frac{3}{15}$, *C* $\frac{1}{6}$ and *D* the rest, *viz.* £2800. *Quere* the Purchase Money, and what must *A*, *B* and *C* respectively pay, and also what part of the Estate must *D* have?

Answer, Purchase Money £12000 whereof *A* must pay £4800, *B* £2400 and *C* £2000, and *D* must have $\frac{7}{30}$ of the Estate.

68. Suppose 3 Reapers *A*, *B* and *C* reaped a certain Number of Acres for £5 8*s* and that they wrought such Parts as are hereafter mentioned, *viz.*

$$\left.\begin{array}{r} A \\ A \\ \text{and } B \end{array}\right\} \text{ and } \left\{\begin{array}{l} B\ \frac{1}{2} \\ C\ \frac{5}{6} \\ C\ \frac{2}{3} \end{array}\right\} \text{ of the Work}$$

Quere what must each Man receive to be paid in proportion to his Work? £ *s* *s* £ *s*

Answer. *A* 1 16, *B* 18 and *C* 2 14.

69. Suppose *A*, *B* and *C* purchased a Machine for £120 and the Profit thereof by agreement to be divided amongst them in Proportion to the Sums they respectively paid which were as follow, *viz.* for every £8 *A* paid, *B* paid £5 and *C* £3, Now suppose they clear £40 *per Cent*. What is each person's Stock with respect to the Sum paid and Gain *per Cent*?

Ans. *A*'s Stock £150, *B*'s £93 15*s* and *C*'s £56 5*s*.

70. Suppose 15 Men, 20 Women and 12 Servants, were to pay 30*s* and that for every 8*d* a Man pays, a Woman must pay 5*d* and a Servant 3*d*. What must each person pay? *d*

$$\text{\textit{Ans.}}\ \left.\begin{array}{r} 11\,\frac{1}{4} \\ 7\,\frac{1}{32} \\ \text{and } 4\,\frac{7}{32} \end{array}\right\} \text{each} \left\{\begin{array}{l} \text{Man's} \\ \text{Woman's} \\ \text{Servant's} \end{array}\right\} \text{Share.}$$

71. Suppose *A* and *B* made a joint Stock and that *A*'s Money lay $2\frac{1}{4}$ Years and *B*'s but $1\frac{3}{4}$ Year. Now if *A* advanc'd £240 10*s* towards the Stock. What must *B* have advanc'd thereto in order to have an equal Share of the Gain?

Answer, £432 18*s*.

72. Suppose four Persons enter'd into Partnership and gain'd £180, and that *A* put into the Stock

	£			
	80	for	6	Months
B	90		10	
C	100		14	
and *D*	110		16	

Quere each Person's Share of the Gain?

		£	s	d
Answer, *A*'s	Share	19	—	$7\frac{1}{4}\frac{137}{227}$
B's		35	13	$7\frac{3}{4}\frac{115}{227}$
C's		55	10	$1\frac{1}{2}\frac{78}{227}$
and *D*'s		69	15	$7 - \frac{124}{227}$

73. Suppose *A* and *B* enter into Partnership and that *A* puts into the Stock £30 for 8 Months. *Quere* how long must *B*'s £40 continue therein in order to have an equal Share of the Gain?

Answer, 6 Months.

74. Suppose *A* hath 80 pair of Stockings worth

	s	d		
	2	6	a pair	ready Money
but	3	2		in barter

and that *B* hath Worsted worth 1*s* 7*d* a pound ready Money. Now if these two Persons barter. How much Worsted must *B* give *A* for the 80 pair of Stockings? *lb.*

Answer, $126\frac{6}{19}$.

75. Suppose *B* a Butcher in order to clear £40 on a Bargain with *D* a Drover rates a certain Number of Lean Cows at $\left.\begin{matrix}\text{£}5\\ \text{£}4\end{matrix}\right\}$ a piece which cost him but and that the Drover being apprized of that, raises the price of his Fat Cows which cost £10 a piece to an adequate price. *Quere* the Number of Fat Cows the Drover must deliver to the Butcher?

Answer, 16 Fat Cows for 40 Lean Ones.

76. Suppose *A* hath Woollen Cloth worth

$$\begin{array}{lcc} & s & d \\ & 5 & - \\ \text{but} & 6 & 6 \end{array}\Big\}\text{ a Yard }\Big\{\begin{array}{l}\text{ready Money}\\ \text{in barter}\end{array}$$

and wou'd barter 60 Yards of this Cloth with *B* for Wheat at 8*s* 6*d* a Bushel but wou'd be willing to abate £15 *per Cent.* to have *half* ready Money. *Quere* the ready Money Price of a Bushel of this Corn, and how much must be delivered, paying one half ready Money?

Answer, $\overset{s}{6}$ $\overset{d}{6}\frac{1}{4}\,\frac{11}{12}$ the Price of a Bushel, and $19\frac{1}{2}$ Bushels to be delivered.

77. Admit a Person sold a Horse for 20 Guineas and lost thereby £24 *per Cent.* How much ought he to have sold the Horse for, in order to have gain'd as much *per Cent.* as he cost him?

Answer, $\overset{\text{£}}{35}$ $\overset{s}{5}$ $\overset{d}{3}\frac{1}{4}\,\frac{145}{361}$.

78. Suppose a Person bought a Hog for 30*s* and that the fattening of which cost $\frac{2}{5}$ of what he was sold for, and that by selling him at 4*d* $\frac{1}{2}$ *per lb.* there was gain'd as much as he cost at first. *Quere* the Weight and what he was sold for? *lb.*

Answer, £5, and the Weight $252\frac{12}{19}$.

79. Sup-

80. Suppose a Person bought a parcel of Hops at 11$d\frac{1}{2}$ *per lb.* but not proving good Ones is willing to sell them so as to lose £10 *per Cent.* How much *per lb.* must they be sold for?

Answer, 10$\frac{1}{4}\frac{2}{5}$ d.

81. If by selling Goods at £2 12*s per* Cwt. there be gain'd £20 *per Cent.* What wou'd have been gain'd *per Cent.* if they had been sold at £3 15*s per* Cwt?

Answer, £73 1*s* 6$\frac{1}{4}\frac{11}{13}$ d.

82. *John* sold his Horse for fifteen pound,
And lost just twelve * *per Cent.*
But shou'd have cleared as he found,
Fifteen † by just Account.
Then how much under Value say,
Has *John's* fine Horse been sold?
Come *Tyro* tell without Delay,
You'll this with ease unfold.

* £
† £ *per Cent.*

Answer, £4 12*s* – $\frac{1}{2}\frac{2}{11}$ d.

83. If a Draper sold Cloth at £5 6*d* a Yard, and gain'd £8 *per Cent.* thereby. What wou'd he have gain'd *per Cent.* if he had sold it at 6*s* 4*d per* Yard?

Answer, £24 7*s* 3$\frac{1}{4}\frac{1}{11}$ d.

84. In 135 Crowns, 34 Sols. How much Sterling at 2*s* 7$d\frac{3}{4}$ *per* Crown?

Answer, £17 18*s* 8–$\frac{29}{30}$ d.

85. Sup-

85. Suppose a Merchant at *London* remit to *Amsterdam* two Bills of Exchange each £300

$$\left.\begin{array}{r}\text{the one}\\ \text{and the other}\end{array}\right\}\text{at}\left\{\begin{array}{ll}s & d\\ 33 & 4\\ 33 & 7\frac{1}{2}\end{array}\right\}\text{Flemish } per \text{ £ Sterling.}$$

How many Guilders *Bank* / how many *Current* Money and are contained therein. *Agio* at $4\frac{3}{8}$ *per Cent*?

	Guilds.	*Stiv.*	*Pen.*		
Ans.	6026	5	—	*Bank*	Money.
and	6289	17	$15\frac{1}{2}$	*Current*	

86. Admit a Merchant to be under a Necessity to exchange £140 *Sterling* for Dollars or Crowns and is offered

$$\left.\begin{array}{r}\\ \text{and}\end{array}\right\}\text{the}\left\{\begin{array}{l}\text{Dollars}\\ \text{Crowns}\end{array}\right\}\text{at}\left\{\begin{array}{ll}s & d\\ 4 & 6\\ 5 & -\end{array}\right\}\text{a piece which are worth but}\left\{\begin{array}{ll}s & d\\ 4 & 3\\ 4 & 8\end{array}\right\}\text{a piece}$$

The Question is which he must take to lose the least Money by, and how many of that sort must he receive?

Answer, $622\frac{2}{9}$ Dollars.

$$\begin{array}{r}\text{If } 4\\ 5\\ 3\\ \text{and } 2\end{array}\left.\right\}\text{Yards of}\left\{\begin{array}{l}\text{Cloth}\\ \text{Fustian}\\ \text{Shalloon}\\ \text{Flannel}\end{array}\right\}\text{be worth}\left\{\begin{array}{l}7\\ 9\\ 4\\ 2 \text{ pair}\end{array}\right.\text{Yards}\left\{\text{of}\right\}\begin{array}{l}\text{Fustian}\\ \text{Shalloon}\\ \text{Flannel}\\ \text{Gloves}\end{array}$$

Then how many Yards of Cloth wou'd be worth 30 pair of Gloves? *Answer*, $7\frac{1}{7}$ Yards.

87. If a Goldsmith melt the following Quantities of Gold together, *viz.*

$$\left.\begin{array}{r}8\\ 16\\ \text{and } 18\end{array}\right\}oz.\text{ of}\left\{\begin{array}{c}20\\ 17\\ 21\end{array}\right\}\text{Caracts fine}$$

Quere the fineness of the Composition?

Answer, $19\frac{2}{7}$.

88. If

88. * If a Vintner were to mix the following Wines, *viz.*

$$\left.\begin{array}{r}\text{Canary}\\ \text{Malaga}\\ \text{and Sherry}\end{array}\right\}\text{at}\left\{\begin{array}{cc} s & d\\ 2 & 4\\ 2 & 8\\ 1 & 8\end{array}\right\}\textit{per}\ \text{Quart}$$

with Water, so that the Mixture may be worth 2*s* a Quart. How much of each sort must he take?

$$\textit{Answer},\ \left.\begin{array}{r}\left.\begin{array}{r}1\\ 1\end{array}\right\}\text{Quart}\\ \left.\begin{array}{r}6\\ \text{and } 2\end{array}\right\}\text{Quarts}\end{array}\right\}\text{of}\left\{\begin{array}{l}\text{Canary}\\ \text{Sherry}\\ \text{Malaga}\\ \text{Water.}\end{array}\right.$$

89 * Suppose a Grocer mixes 30 ℔ of Sugar at 4*d per* ℔, with three other sorts at 5*d*, 7*d* and 8*d per* ℔, and charges the same at 6*d per* ℔. What wou'd the Weight of the Mixture be? *Answer*, 90 ℔.

90. * Admit a Grocer wou'd mix four different sorts of Tea, *viz.* at 5*s*, 6*s*, 7*s* and 9*s per* ℔, in order to sell the whole Mixture of 80 ℔ at 8*s per* ℔. How much of each sort must he take?

Answer, $8\frac{8}{9}$ ℔ of each of the three first sorts, *viz.* at 5*s*, 6*s* and 7*s* } *per* ℔.
and $53\frac{1}{3}$ ℔ of that at 9*s* }

* *Note* These three Questions, *viz.* 88, 89 and 90 are indeterminate and will admit of various Answers each, as may be seen in *page* 398.

91. Suppose a Debt is to be discharged at six different Payments in Arithmetical Progression, and that the first Payment is to be £4 and the last £80. *Quere* the whole Debt and what each Payment must be?

Ans. £252 the whole Debt = £4 + £19 4*s* + £34 8*s* + £49 12*s* + £64 16*s* + £80 the six different Payments.

92. Admit

92. Admit a Post to ride at the rate of 9 Miles an Hour, and that a person follows him in a progressive Motion riding $\left.\begin{matrix}3\\5\\7\end{matrix}\right\}$ Miles the $\left\{\begin{matrix}1\text{st}\\2\text{d}\\3\text{d}\end{matrix}\right\}$ Hour and so on increasing every Hour 2 Miles. In what Time wou'd the Post be overtaken? *Ans.* 7 Hours.

93. Suppose a Person went a Journey, and rode $\left.\begin{matrix}6\\ \text{and } 50\end{matrix}\right\}$ Miles the $\left\{\begin{matrix}\text{first}\\ \text{last}\end{matrix}\right\}$ Day and increased his Journey every Day 4 Miles. How many Days did he travel? *Ans.* 12 Days.

94. Suppose a young Spark on meeting a Goffard driving 17 Geese ask'd him the Price of 'em, and that the Goffard (not caring to give a direct Answer) told him if he wou'd pay for the first Goose one Farthing and double it to the 16th, the 17th he shou'd have in at the Bargain. Now if the Spark had agreed to this proposal, pray what wou'd they have been sold for a Piece one with another?

Answer, £4 –*s* $3\frac{3}{4}$*d*.

95. In a Town lives a Cobler call'd *comical John*
An excellent Artist at cracking a *Pun*.
It happen'd one Day, at the Sign of the *Trunk*,
He met with a jovial young Farmer half drunk.
Who was rattling much of *Arithmetic Rules*
Making People around look like *Ninnies*. or *F—s*.
Says the Cobler —Sir I've a Coat you may see,
Perhaps as old fashion'd as any there be.
At which are five dozen plate Buttons all fair,
Which I gladly wou'd sell, as the Times you know are
Very tight, that a poor Man can scarce earn his Bread,
Tho' he toil 'till his Teeth all drop out of his Head.
The Farmer he listen'd to hear the Man's Tale,
And gave him to drink a full Bumper of Ale.

The

Then aſk'd him the price of the Buttons he'd ſell,
What they're worth ſays the Cobler I cannot now tell.
But if ev'ry Button you'll treble for me,
With one Barley Corn * then the Buttons ſhall be,
Your own—To this Bargain the Farmer agreed
And began to count up the whole Number with ſpeed,
But to his Surprize found he's bilked indeed.
For the Barley Corns growing upon all his Land,
Were nothing to what was the Cobler's Demand.

Quere the Number of Barley Corns, and Number of Buſhels and alſo what it will amount to at 4*s* 4*d*. a Buſhel allowing 681 Grains of Barley to an Ounce, 16 Ounces to the pound, and 50 pounds to the Buſhel (that is to ſay) 544800 Grains to every Buſhel ?

Anſwer 21195579137608101757147216600 Barley Corns, *viz. twenty one thouſan one hundred and ninety five millions of millions of millions of millions, five hundred and ſeventy nine thouſand one hundred and thirty ſeven millions of millions of millions, ſix hundred and eight thouſand one hundred and one millions of millions, ſeven hundred and fifty ſeven thouſand one hundred and forty ſeven millions, two hundred ſixteen thouſand and ſix hundred*, which at 544800 Grains to the Buſhel make 38905248049941449627656 $\frac{1139}{2724}$ Buſhels, *viz. thirty eight thouſand nine hundred and five millions of millions of millions, two hundred and forty eight thouſand and forty nine millions of millions, nine hundred and forty one thouſand four hundred and forty nine millions, ſix hundred and twenty ſeven thouſand ſix hundred and fifty ſix Buſhels and a little more than a Peck*, which at 4*s* 4*d* a Buſhel amount to £8429470410820647419325 11*s* 1 $\frac{1}{2}$*d*, in words, *eight thouſand four hundred and twenty nine millions of milli-*

* *i.e.* One Barley Corn for the *firſt Button*, 3 for the *ſecond* and ſo on, trebling each time to the *laſt*.

ons

ons of millions, four hundred and seventy thousand four hundred and ten millions of millions, eight hundred and twenty thousand six hundred and forty seven millions, four hundred and nineteen thousand three hundred and twenty five pounds, eleven shillings and three halfpence, which Sum is so *very great* that if it were possible for *nine hundred thousand men* to pay *each, nine hundred thousand pounds a day*, they wou'd (at that *great daily Sum* and at 365 Days to the Year) be more than *twenty eight millions five hundred and eleven thousand six hundred and fifty Years*, in paying the same ——*SUCH IS THE AMAZING POWER OF NUMBERS!*

96 Ingenious *Tyro* tell me pray,
How many diff'rent hands there may
(Of Cards) be held at th' Game of Whist?
But pray in *Gaming* don't persist.

This Question is the same as if one were to ask how many different Parcels of 13 in each Parcel, may be taken out of 52, *i. e.* how many Combinations of 13 in 52?

Answer, 635013559600.

97. Suppose three Timber Merchants *A*, *B* and *C*, bought a Parcel of Timber for £340 11s 6d and that

$$\left.\begin{matrix} A \text{ paid } \frac{1}{3} \\ \text{and } B\ \frac{1}{5} \end{matrix}\right\} \text{as much as} \left\{\begin{matrix} B \\ C \end{matrix}\right.$$

Quere what did each pay?

	£	s	d		£	s	d		£	s	d
Ans. A paid	17	18	6,	*B*	53	15	6,	and *C*	268	17	6.

98. Admit a Person paid a Debt of £45 with Guineas and Moidores, and that for every Moidore he paid 3 Guineas *Quere* the Number of each?

Answer, 30 Guineas and 10 Moidores.

99. Admit

99. Admit a Farmer paid £4 8*s* amongst his Labourers in manner following *viz.*

$$\left.\begin{array}{l}\text{to every}\left\{\begin{array}{ll}\text{Man} & 12\\ \text{Woman} & 6\end{array}\right.\\ \text{and to every Boy} \quad 4\end{array}\right\}d$$

$$\left.\begin{array}{r}\text{and that}\\ \text{and}\end{array}\right\}\text{for every}\left\{\begin{array}{l}\text{Boy}\\ \text{Woman}\end{array}\right\}\text{there were}\left\{\begin{array}{l}\text{2 Women}\\ \text{3 Men.}\end{array}\right.$$

Quere the Number of each?

Answer, 12 Boys, 24 Women, and 72 Men.

100. Suppose a Gentleman as he rode through a Village observ'd the people erecting a May-Pole and that upon his asking the Height was answer'd, that if

$$\left.\begin{array}{r}\frac{2}{3}\\ \text{and }\frac{5}{12}\end{array}\right\}\text{of the Height}\left\{\begin{array}{l}\text{be multiply'd by 6}\\ \text{deducted from that Product}\end{array}\right.$$

the remainder will be 215 Feet. *Quere* the Height?

Answer, 20 Yards.

101. Suppose a Person on being asked what o'Clock it was replied, the Hour is

$$\left.\begin{array}{r}\frac{1}{5}\text{ of the}\\ \text{and if those}\end{array}\right\}\text{Minutes}\left\{\begin{array}{l}\text{since the Clock did strike}\\ \text{were multiply'd}\end{array}\right.$$
$$\text{and that Product divided}\left.\begin{array}{l}\\ \end{array}\right\}\text{by}\left\{\begin{array}{l}6\\ 8\text{, the}\end{array}\right.$$

Quotient wou'd be 30. *Quere* what o'Clock it then was?

Answer, 40 Minutes past 8.

102. Admit a Person bought 100 Sacks of Flour of two Sorts for £92, *viz.*

$$\left.\begin{array}{r}60\\ \text{and }40\end{array}\right\}\text{Sacks of a}\left\{\begin{array}{l}\text{fine}\\ \text{coarse}\end{array}\right\}\text{Sort}$$

$$\left.\begin{array}{r}\text{and that}\\ \frac{1}{4}\text{ more than what}\end{array}\right\}\text{he paid for each of the}\left\{\begin{array}{l}60\\ 40\end{array}\right\}\text{Sacks}$$

Quere, what did he pay a Sack for each?

$$\textit{Answer},\ \left.\begin{array}{rr}\pounds & s\\ 1 & -\\ \text{and} - & 16\end{array}\right\}\text{a Sack for the}\left\{\begin{array}{l}\text{fine}\\ \text{coarser}\end{array}\right\}\text{Sort.}$$

103 Admit

103. Admit a Grocer wou'd mix two sorts of Tea together, *viz.*

$$\left.\begin{array}{r}\text{the one}\\ \text{and the other}\end{array}\right\}\text{Sort at}\left\{\begin{array}{cc}s & d\\ 4 & 6\\ 5 & 8\end{array}\right\}\textit{per}\ \text{lb}$$

and wou'd have the whole Mixture to to weigh 40 lb and be worth £9 17*s* 6*d*. How much of each Sort must he take for that purpose?

$$\textit{Answer},\ \left.\begin{array}{r}lb.\\ 25\\ \text{and } 15\end{array}\right\}\text{at}\left\{\begin{array}{cc}s & d\\ 4 & 6\\ 5 & 8\end{array}\right\}\textit{per}\ \text{lb.}$$

104. A Farmer once his Lab'rour set
A Job——twelve days to do——
And sixteen pence *per* day he'd give,
But then 'twas order'd so,
That *John* shou'd forfeit eight pence, for
Each Day that e'er he play'd,
Because he apt to fuddle was,
So was the Bargain made..
At last just half a Guinea he
Receiv'd.——Then tell me pray,
What Days he work'd, what idle was?
Do this without delay.

$$\left.\begin{array}{l}\textit{Answer},\ \text{Work'd } 9\tfrac{1}{4}\\ \text{and Play'd } 2\tfrac{3}{4}\end{array}\right\}\text{Days.}$$

105. Suppose a person receiv'd a Legacy of £150 in Six-and-thirties, Moidores and Guineas

and { that the whole / the Guineas $\frac{1}{5}$ of } the } Number of { Pieces were 100 / Moidores. / *Quere* each?

Answer, 40 Six-and-thirties, 50 Moidores and 10 Guineas.

106. If

106. If $\frac{2}{3}$ of my Age be added to $\frac{3}{7}$ thereof, and that Sum multipli'd by 12, Product divided by 6, and that Quotient made less by 9, the remainder will be 83 *Quere* my Age at the time of making this Question?

Answer, 42 Years.

107. Th' Age of a Lady you quickly may find,
From what you observe * hereunto's subjoin'd.

* The Square of her Age being multiplied by it's Cube and that Product divided by 320, the Square Root of the Quotient will be 100.

Answer, 20 Years.

New ARITHMETICAL PARADOXES *for the Amusement of Youth.*

PARADOX 1.

ONE and *two*, when they're wrote down fair,
Will make *one hundred* I declare.

PARADOX 2.

Take *one* from *nineteen*, th' remainder you'll see
Is *twenty* exactly, pray how can this be.

PARADOX 3.

Prime numbers *four*, so wrote may be,
Just *eighty eight*, their sum you'll see;
But if from *eighty eight* you take
One o'th' numbers, then th' sum will make
No more (I say) than *eighty three*,
Pray tell me how this thing can be?

PARADOX 4.

The ſum of *four* figures in value will be,
Above *ſeven thouſand, nine hundred* and *three* ;
But when they are halved, you'll find very fair,
The ſum will be *nothing*, in truth to declare.

PARADOX 5.

The ſum of *nine* figures, a number will make,
From which if juſt *fifty* you're pleaſed to take,
One third of that number remains ſtill behind,
This nnmber young *Tyro* be pleaſed to find ?

PARADOX 6.

Six hundred and *ſixty* ſo order'd may be,
That if you divide the whole number by *three*,
The quote will exactly in numbers expreſs,
The half of *ſix hundred* and *ſixty* not leſs.

PARADOX 7.

Come tell to me, what figures *three*,
When multipli'd by *four*,
Make *five* exact, 'tis truth in fact,
This *Tyro* pray explore ?

PARADOX 8.

George paid his *Uncle* as we find,
One hundred pounds juſt to his mind ;
To his *firſt Couſin Simon Reade*,
Juſt the ſame ſum he likewiſe paid ;
But had in caſh at firſt not more,
In *Britiſh* pounds, than juſt *five ſcore*,
How this cou'd be, I pray explore.

PARADOX 9.

Juſt *one pound ten* * will name a *Man*, * *ſhill.*
His *Sign* likewiſe, 'tis not the *Swan* :
Come tell this *Landlord's Name* and *Sign*,
That *John* may know to call and dine.

PARA-

PARADOX 10.

A famous *Quack Doctor*, of ſkill moſt profound,
Receiv'd of his patients juſt *one hundred pound*,
It being in ſilver, bids *Merry* his man,
To count it him over, as ſoon as he can;
He counted the money, then *Maſter* quoth he,
Here's *one hundred* for *you*, and *ſomething* for *me*,
You're wrong, (ſays the *Doctor*) that never can be.
But ſoon he perceived his money made more,
By *Merryman*'s method of counting it o'er:
So liking the fancy, ſaid, take what remains,
It was more than *eight pounds* he got for his pains.
How *Merryman* counted the money declare,
To gain ſuch a ſum from *one hundred pound*—fair.

PARADOX 11.

Twelve *merry Men* did in my garden ſtand,
All in a row, upon this fertile land.
At equal diſtance plac'd—the row in view,
Was *twenty yards* in length, when meaſur'd true,
Theſe Men replac'd,—ſtand in a row once more,
At the *ſame diſtance*, as they were before.
The length of ground, on which they fairly ſtand,
Is now no more than *thirteen yards* of land,
How is this done, come *Tyro* tell to me,
And with a *Laurel* you ſhall crowned be?

PARADOX 12.

How in two parts muſt I divide
A board that's juſt *nine inches* wide,
And *ſixteen* long, I pray declare,
To fill a hole juſt *one foot* ſquare.

CONCLUSION.

To the *Tyro*'s in ARITHMETIC.

YE *British* Youths, with emulation strive,
And to this Port, or Page, you'll soon arrive.
The track so easy, ev'ry Rule so clear,
Nought can obstruct you to your Passage here.
No dang'rous Cliff, no Cape to weather round,
Quite smooth and easy, ev'ry Course is found.
That with delight you may the Harbour gain,
Where *Knowledge* spreads her Sails, & wafts the Main,
With golden breezes, to enamour Youth,
To catch the Gales of Reason, Sense and Truth.
Knowledge! that dear refiner of the Soul,
Bids thought take wing, and fly beyond the Pole,
High thro' the Clouds, to soar above the Sky,
And prove Creation in a *Deity*.
Knowledge! (like *Ariadnes'* thread) leads thro',
Lab'rinths of Learning, Studies ever new.

FINIS.

ADVERTISEMENT.

THE *Author* of this *Treatise* begs leave to return his sincere Thanks to all those *Ladies* and *Gentlemen* (in Number above eight hundred) who have been pleased to become Subscribers thereto, and hopes they will excuse him for not publishing their Names as he at first proposed, being prevented therefrom by the Book being carried to a greater Size than the Price fixt upon it will bear, having, in order to render every thing complete, extended its length above

above one hundred and fifty Pages more than it was at first intended to be, so that the whole has run him to above one fourth more in charge of Printing, *&c.* which he hopes his generous Subscribers will take into Consideration.——And further begs leave to inform them, and all other Lovers of Learning and Ingenuity, into whose Hands this may happen to come, that he will (*if proper Encouragement be given him*) continue and publish by *Subscription*, in half-Yearly Numbers, *The MUSES CABINET*, or *DELIGHTS for the INGENIOUS*.——This Work will consist of two Parts, and will contain a deal of *Amusement*, as well as *Instruction* for *both Sexes*. Part 1st will contain (in every Number) many *useful*, as well as *delightful Curiosities*, such as *Original Poems*, *moral* and *instructive Tales*, *New Enigmas*, *Rebuses*, *Paradoxes*, *Queries*, &c. with Answers thereto by various Correspondents. Part 2d. will contain (by way of Recreations) every thing that is useful and required in *Practical Mensuration;* such as the *best* and *easiest Methods* to measure all kinds of *Artificers Work*, *Boards*, *Timber*, &c also, to *survey Land*, *gauge all kinds of Vessels*, *measure Marl-Pits* and *Hay-Reeks*, also how to *Level*, find *Heights*, *Depths* and *Distances*, &c. with a great Variety of *new* and *useful Numerical Questions* by several Ingenious Correspondents, with the Answers thereto, in each succeeding Number.——This Work he hopes to complete in twelve Numbers, so as to make two handsome Volumes in large *Octavo*, every Number of this Work will be decorated with an elegant Copper-Plate, and the whole will be a *complete Repository* of the most useful Parts of *Practical Science* ——The first Number of this Work lately published, having fallen into the Hands of several *Ladies* and *Gentlemen* in different Parts of the Kingdom, whose Abilities are eminent in the most polite Parts of Literature have given it their Approbation, and promised to furnish the Author with several valuable Manuscripts and proper Materials suitable for the Work, so that he

he hopes he shall be enabled to make it the *most delightful* as well as *instructive Miscellany* ever offer'd to the Public ——As the Author intends to have no more Copies printed of the abovementioned *Miscellany* than what shall be subscribed for, he therefore desires those Persons who chuse to be Subscribers thereto, to send him their Names (*Post-Paid*) as soon as possible, that it may be ascertained what Number, of Copies of the second Number may be got printed by their most obedient

humble Servant,

Whitchurch, THO. SADLER.
June 7th, 1773.
